A STUDY OF TWO METHODS OF TEACHING GENERAL SCIENCE IN THE TENTH GRADE AT THE ATHENS HIGH AND INDUSTRIAL SCHOOL, ATHENS, GEORGIA

A THESIS

SUBMITTED TO THE FACULTY OF ATLANTA UNIVERSITY

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR

THE DEGREE OF MASTER OF ARTS

BY

EUGENE T. HOLMES

SCHOOL OF EDUCATION

ATLANTA, GEORGIA

AUGUST 1951

R = iv T = 35

ACKNOWLEDGMENT

First, I wish to acknowledge with many thanks to Dr. R. O. Johnson and Mr. B. F. Bullock, my advisors for their invaluable guidance, advice and patience which enabled me to make this accomplishment.

To my dear wife, Mrs. E. T. Holmes, I am most grateful for her kindness, good deeds and patience in maintaining my work the past three summers with the Adult Program in Athens, Georgia, while I was pursuing my degree.

I also wish to extend thanks to Mrs. Anna Bell Jarrett, Assistant Reference Librarian for the materials made available to me at the Trevor Arnette Library, Atlanta University, and to the personnel of the University of Georgia Library Staff.

--ETH--

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

Statement of Problem.--The "methodology"of the instruction and the relative value of one method over that of another constitutes one of the crucial problems of the educative process. Therefore this experimentation was to determine the relative value of the "field-trip method" of instruction as compared with the "textbook method" of instruction in general science at the Athens High and Industrial School, Athens, Georgia.

Purpose of Study.--The purpose of this study was to test by experimentation the null hypothesis that there is no difference in the relative effectiveness in the "field-trip method" and the "textbook method" of instruction in teaching general science in the 10th grade.

Definition of Terms.--Certain terms used in this study have been defined to provide a clear understanding of the way they have been used.

The "textbook method" may be defined as that teaching procedure in which the mastery of the textbook is the immediate objective.[1] The "textbook method" as used in this study is construed to mean teacher-pupil participation in planning what, to do, to study, in small group undertakings and the interchange of opinions through group and class discussion on materials included in the textbook, and apparatus found in the laboratory and classroom setting.

The "field-trip method" as used in this study is construed to mean teacher-pupil participation in planning, what to do and the combined

---

[1] E. B. Wesley, Teaching Social Studies in High School (New York, 1950), p. 445.

participation of persons involved in the management of places to be visited and the interchange of opinions through discussion of experiences exposed to outside of the classroom.

The difference between the "textbook method" and the "field-trip method" of instruction as stated in the above definition is the fact that the center of experience in one method was the textbook and the laboratory in classroom setting, while in the other the experiences were centered in directed visits made to places of interest which were related to the units of work.

Method of Procedure.--The California Test of Mental Maturity was administered at the beginning of the school year 1950-51, to sixty-five pupils enrolled in the general science class at the Athens High and Industrial School, Athens, Georgia. After the test had been scored and the results recorded the writer divided the subjects into two groups, equating them on the basis of the results of the scores of the California Test of Mental Maturity. Of the sixty-five pupils tested one was dropped due to the extremely low score made on the intelligence test, a second pupil was dropped due to the extremely high score made on the intelligence test, and three boys withdrew to enter the Armed Services which left sixty subjects to be included in the study.

The writer then administered the Ruch-Popenoe General Science Test Form A to both groups. This test is designed to measure the achievement before taking the course in general science.

Time for administering the test is limited to forty minutes (40) plus fifteen minutes (15) for giving directions and distribution of pencils and test forms. Two fifty-five minutes (55) periods were used to administer

the test, one for group A the "field-trip group" and one for Group B the "textbook" group. The mean score for each group was computed.

On September 15, 1950, the writer introduced the problem to the two groups at their regular class periods. Each group was organized for carrying on the work of the course. Each group was divided into three sub-committees with a secretary and an assistant secretary for each sub-committee. The writer spent two periods with each group planning the work for the next fifteen weeks. Eight units of work were agreed upon. These were:

1. Water Sanitation
2. What Things are Made of (Matter)
3. The Air and How It Controls Us and How We Controls It
4. The Power to Do Things
5. Heat and Light Energy
6. Sound
7. Living Things
8. The Science of Keeping Fit

With Group A, each unit was preceded by planning for visits to places of interest in the community which would help students understand the various aspects of the unit under study. The writer guided the group by pointing out the things to look for in each unit. With Group B, the writer planned with the students the materials to be used both in the classroom and the laboratory, together with materials found in the library that would help them understand the various aspects of the units under study.

The writer attempted to motivate Group B by creating within the group a competitive attitude and an appreciation for the experiences that were definitely different from any other group that had enrolled in a general science class at the Athens High and Industrial School. The writer attempted to motivate Group B by creating a competitive attitude within

the group and an appreciation for the opportunity to have a part in a piece of work in which they might be proud of as coming out of the efforts of this particular group.

The writer attempted to guide the attainment of the two groups by administering a teacher made test at the end of each unit, and after the tests were scored the writer placed the scores of each group on the school bulletin board that the pupils might be inspired to do a better job on each succeeding unit. At the expiration of the sixteenth week the Ruch-Popenoe General Science Test Form B was administered to both groups as the final test. The scores were compiled and computed for the mean, standard deviation, standard error, the standard error of the difference between the mean, and for the value of "t".

Since the groups were not equated on the basis of sex, the writer felt the need for determining if the sex factor had influenced the scores. The mean score for the boys and the mean score for the girls in each of the two groups were computed. The difference between the mean scores of boys and girls within each group was obtained and tested for the significance of the difference by Fisher's "t". Further, the difference between the mean score of boys in Group A and boys in Group B was obtained and tested for the significance of the difference by Fisher's "t", the same procedure was used for the girls of each group. These data are presented in table form, analyzed and interpreted in Chapter II.

The Value of the Study.--The finding resulting from this study should have considerably practical value to the teachers of science courses in the Athens High and Industrial School, and to administrators to the end that if any significant difference is found in either direction they may

be inspired to provide materials and opportunities for the methods to be further explored. If for example, it should be found that a specific type of method of teaching general science at the high school level appears to be significantly more effective than another it would seem to be justifiable to follow such a method of instruction, or it may serve to give a new slant on the advantage of one method and the disadvantage of the other.

Pertinent Literature.--There are many studies in the field of experimental methods of teaching science. Many authors have also stated points of view regarding methods of teaching in general and science particular. Authorities have committed themselves to the theory that "methods" have a broader implication than "techniques" which are merely the means employed in methodology. Methodology has educational objectives in view.[1] The objectives are mainly to produce self-activity among the pupils.

The newer methods place emphasis on the problem solving in the area of real experiences. They call for a certain organization of materials of learning.

The numerous types of plans that characterize planned instruction today reflect earlier contributions. These include:

1. Herbart's five steps in the teaching process: (1) preparation, (2) presentation, (3) comparison, (4) generalization or abstraction, and (5) application.[2]

---

[1] M. P. Moffatt, Social Studies Instruction (New York, 1950), pp. 490-1.

[2] Ibid., pp. 388-91.

2. Kilpatrick's four steps in purposeful activity: (1) purposing, (2) planning, (3) executing, and (4) judging.[1]

3. Dewey's five steps in the analysis of a complete act of thought: (1) a felt need or difficulty, (2) its location and definition, (3) suggestion of possible solution, (4) development of reasoning of application of the suggestion, and (5) further observation and experimentation leading to its acceptance or rejection.[2]

Wesley believes that method is a process composed of several steps, many of the steps or elements used in a particular method are also used in other methods. The combination of these elements into an effective process is the responsibility of the teacher. The teacher can synthesize the disjointed elements into a functional whole. Method is therefore, one of the most fundamental aspects of education and the central problem of teaching. It is difficult to determine the respective merits of two methods for each subject, if the two methods have the same elements, however, it is possible to isolate one from the other provided that certain elements of one are carefully eliminated from the other.

Methods may be classified according to certain bases, for example:

1. Methods based upon equipment
   a. Textbook method
   b. Construction projects

2. Methods based upon organization of materials
   a. Genetic
   b. Chronological
   c. Psychological

---

[1] M. P. Moffatt, Social Studies Instruction (New York, 1950), pp. 388-91.

[2] Ibid.

There may be many such classification, but the difference depends upon the ability of the teacher to keep particular elements of one isolated from the other.[1]

Edgar Dale says:

> That field-trips are planned visits made to points outside of the classroom, in organized form directed by the instructor. The chief difference between the field trip and the classroom or textbook method of instruction is that the students get their information or experiences in the field and not from the textbook or classroom. The field trip then, is a going out process in which students study the work-a-day world in operation. It is a serious educational study aimed to reach important, planned purposes. The educational theory of the field trip is that you discover, what something means by responding actively to it.[2]

It is the writer's belief that you cannot learn what something means merely by repeating in a dictionary, or encyclopedia and then repeating what was said on the printed page, the more meaning comes when we can bring activity through experience. The amount of facts that can be learned on a trip is endless.

Dale says:

> Our richest experience and thus our richest meanings come only when we respond both physically and mentally to a new situation. He further says that we learn, then, that life is learned through living it. We learn that living is not something that can be neatly divided into school and life. We learn that unless school is life and life is school, we miss many opportunities for effective and permanent learning.[3]

M. C. Richardson and G. H. Smith made a study of "Movies versus Reading" in which they used one hundred twenty (120) Junior High School subjects

---

[1] E. B. Wesley, Teaching Social Studies in High School (New York, 1950), p. 421.

[2] Edgar Dale, Audio Visual Methods in Teaching (Ohio State University, 1946), pp. 134-35.

[3] Ibid., pp. 134-9.

and two hundred seventeen (217) Senior High School subjects. Fifty-five junior high subjects were used for the experimental group and sixty-five junior subjects for the control group. The group that obtained its information from the films were labeled as experimental group, and the group that obtained its information from reading as controlled group.[1]

The senior high groups were composed of 112 for the experimental and 104 for the controlled group. They found that the gains were exceedingly high with those that got their information from pictures over those that obtained theirs from reading.

W. S. Curd, did a study, "The Value of the Field Trip in the Teaching of General Science in Secondary Schools." He used equivalent groups, equated them on the basis of the Intelligence quotients, and checked the consistency using the initial achievement scores. The course given was the same to both groups of pupils. One group studied the materials found in the field, while the other group studied the materials of the text book and laboratory in the classroom. He found that it was not a perfect experiment, because there were too many uncontrollable conditions and variables, both in the classroom and the field trip, but it was true in purpose and in point of view. Its repetition under better condition might yield results and conclusion on higher and higher levels of generalization in the thinking process.[2]

Martin L. Roberson conducted a study with sixty fifth grade children

---

[1] Meline Claff Richardson and Gertrude Hjorth Smith, "A Study of Movies Versus Reading," Clearing House, XX (September, 1943), 15-19.

[2] W. S. Curd, "The Value of Field Trips in the Teaching of Secondary School Subjects, "Unpublished M. A. thesis, Colorado State Teachers College, 1925.

in The Oxford School, Dearborn, Michigan, in 1930. He paired his subjects from the average scores earned on seven units of the Sangren Woody Reading Test that he administered at the beginning of the study, and the scores earned on the subject matter test.

The paired groups were deemed equivalent on each unit, since the difference in the means divided by the standard deviation of the difference of the mean in no instance was greater than 0.96. He rotated the groups and determined the effectiveness of teaching by averaging the gains on the unit of each tested group.

He found that the group that used the developmental discussion method had a slight advantage over the study method group, though not statistically significant.[1]

Jebbie Cecil Billue did a study at the University of Georgia, in 1950, of certain performances of first year college students who had elected to take physics and chemistry in high school and those that did not elect to take them in high school, he found that on a science test that those that elected to take physics and chemistry in high school did significantly better than those that did not.[2]

Jamie G. Martin made a study of "audio-visual aids" and the "traditional recitation method" of instruction, she equated the groups on

---

[1]Frances D. Curtis, Second Digest of Investigation in the Teaching of Science (Philadelphia, 1925), p. 58.

[2]Jebbie Cecil Billue, "A Study of Certain Performances of First Year College Students Who Elected to Take Physics and Chemistry in High School and Those That Did Not." University of Georgia, Athens, Georgia, Unpublished M. A. thesis, School of Education, University of Georgia, 1950, p. 14.

the scores earned on the intelligence test and the initial achievement test. She found that the group taught with the aid of audio-visual materials scored slightly better than the traditional recitation, but not statistically significant.[1]

Aletha Bailey made a comparative study of two methods of teaching typing, the "Whole Method" and the"Part Method" at the Athens High School, Athens, Georgia, 1933.

She used 15 students in each of the two groups. One was labeled as group A and the other as group B. She matched her groups from the scores earned on an intelligence test and a mechanical ability test. She worked her groups for twenty weeks including the time allowed for administering the two test, (intelligence, and mechanical ability) and for matching the groups.

She found that the group taught by the whole method scored slightly higher than did the group taught by the part method, but found no statistical significance.[2]

Ora D. Logan made a study of community resources as materials for instruction in social studies in Atlanta, Georgia. She used all teachers of social studies in the Atlanta Negro High Schools and 200 High School Pupils together with persons managing community resources in and around Atlanta. The managers of community resources were interviewed, while the

---

[1] Jamie G. Martin, "A Study of Audio-Visual Aids Versus Traditional Recitation Methods of Instruction at the W. H. Crogman Elementary School." Unpublished M. A. thesis, School of Education, Atlanta University, 1950, p. 14.

[2] Aletha Bailey, "A Study of Two Methods of Typing in The Athens High School, Athens, Georgia." Unpublished M.A. thesis, School of Education, University of Georgia, 1933, pp. 11-12.

data from teachers and students were gathered by questionnaires and check-lists.

She found from her check-lists that on one question which reads: Did the field-trip help you better understand what the class discussed? That 65 per cent of the people or pupils replied that they understood better after the trip and that 95 per cent felt that the trip increased their interest in the class work, and that they would like to make the field-trips more frequently.[1]

The Committee on Procedure of the Georgia Program of Instruction prepared a report entitled, "The Community As a Source of Materials of Instruction" to be distributed to the teachers of Georgia in 1937." In reply to a question, why study the community? The committee replied:

> The pupil and the environment are inseparable, his needs and interest arises from his environmental conditions. That every pertinent problem of living as outlined in the Georgia scope of the curriculum takes root in the environment.

Three general techniques were suggested in making any community study, (1) observation, (2) interview and research, which may be used through personal investigation, (3) pupil-teacher activity and laymen school co-operation.[2]

Cecil Long Edwards made a study of the "textbook method" and the

---

[1]Ora D. Logan, "A Study of Community Resources as Materials of Instruction in Social Studies in High Schools for Negroes in Atlanta, Georgia." Unpublished M. A. thesis, School of Education, Atlanta University, 1945, pp. 10-11.

[2]Georgia State Department of Education, "The Community As a Source of Materials for Instruction," Georgia Program of Instruction (Atlanta, Georgia, 1938).

"lecture method" of instruction in the teaching of general science in the W. H. Crogman Elementary School, Atlanta, Georgia, in 1949. She found no significant difference in the use of either method over the other. She used fifty pupils, twenty-five in each group.[1]

John E. Corbally studied the effectiveness of the "assignment method" and the "unit method" in the teaching of general science, and he found that the "unit method" was slightly better in his situation than the "assignment method," but so slight that no superiority could be claimed for either method.[2]

---

[1] Cecil Long Edwards, "An Experimental Study of the Two Methods of Science Teaching in the Seventh Grade at the W. H. Crogman Elementary School, Atlanta, Georgia." Unpublished M. A. thesis, School of Education, Atlanta University, 1949.

[2] Frances D. Curtis, op. cit., p. 60.

CHAPTER II

PRESENTATION, ANALYSIS, AND INTERPRETATION OF DATA

Introductory Statement.--The sources of data for the tested differences between the "field-trip method" and the "textbook method" of teaching science in the 10th grade at the Athens High and Industrial School, were the scores earned by the sixty subjects studied on the basis of the following tests:

1. California Test of Mental Maturity, Advanced Series
2. Ruch-Popenoe General Science Test, for High School, Form A
3. Ruch-Popenoe General Science Test for High School, Form B

The data revealed by the scores on the above tests as earned by the subjects of the two groups will be discussed in this chapter. The data gathered from the test results have been organized and presented in appropriate tables; the ungrouped scores obtained by the sixty subjects on each of the Science Tests are given in the Appendix.

Description and Selection of Subjects and Materials.--The subjects used in this study were the sixty students enrolled in the 10th grade course in general science at the Athens High and Industrial School, Athens, Georgia. The sixty subjects were divided on the basis of the scores earned on the California Test of Mental Maturity, Advanced Series, into two equal groups. Group A--the "field-trip group" consisted of fifteen girls and fifteen boys. Group B--the "textbook group" consisted of twenty-five girls and five boys.

The community resources, related to the units of work, used by Group A included the City Water Works of Athens, two bakeries, the University of

Georgia Dairy and Creamery, the Georgia Power Company Demonstration School, the City Iron Foundry, the Atlantic Ice Company, a flower shop, slaughter house, the University of Georgia Green-House, the Coca Cola Bottling Company, the WGAU Radio Station, the New Athens High School which was under construction, the Anderson Machine Shop, and the County Health Department.

The textbooks used by Group B included the following:

1. Useful Science for High School, Henry T. Weed, Frank A. Rexford and Franklin B. Carroll, (Atlanta, 1939), The John C. Winston Company.

2. Science for Everyday Use, Victor C. Smith and B. B. Vance, (New York, 1946), J. B. Lippincott Company.

3. Careers in Science, Phillip Pollack, Evelyn Stuks and H. C. Madsen, (New York, 1945), Dutton Company.

The California Test of Mental Maturity, Advanced Series is devised for use with students in senior high school, college, and with adults. It contains materials of sufficient range and diversity to indicate the degree of maturity in relation to the major factors involved in intellectual capacities as well as a general measurement of mental maturity.

> In general, the test samples, the maturity of memory, of apperceptive processes; of spatial relationships; and logic and mathematical aspects of reasoning. Certain sub-tests are presented in verbal, and others in non-language form in order to obtain a separate evaluation of each of these aspects of mental maturity.
>
> Each battery is built upon a plan which (1) takes into account recognized mental processes or functions, and (2) corresponds with present knowledge of the nature of mental growth and development.[1]

---

[1] E. T. Sullivan, W. W. Clark and E. W. Tiegs, "Manual of Directions," California Test of Mental Maturity, Advanced Series. High School, California Test Bureau, Hollywood, California.

The Ruch-Popenoe General Science Tests, for High School Form A and Form B are designed to measure the accomplishment of pupils in high school. It is divided into two parts. Part I is composed of fifty items of general science knowledge, principles, concepts, terms, definitions, and applications. Part II is designed to measure the ability of pupils to identify apparatus, organisms, structures and principles, and to apply principles of science to the solution of simple problems. The subject matter of these tests consist of biological science (botany, physiology and zoology) 30 per cent, chemistry 12 per cent, physics and mechanical application 38 per cent, and earth science (agriculture, astronomy, and geology) 20 per cent. The reliability of these tests is considered very high.[1]

The data regarding sex, chronological age, and mental age which are descriptive of the pupils concerned in this study are presented in Table 1.

Group A consisted of fifteen girls and fifteen boys, and ranged in chronological age from 173 months or 14 years and 6 months to 192 months or 16 years. Group A ranged in mental age from 127 months or 10 years and 7 months to 212 months or 17 years and 8 months. The mean chronological age for Group A was 189.3 months or 15 years and 8 months. The mean mental age was 167 months or 13 years and 11 months.

Group B consisted of twenty-five girls and five boys, and ranged in chronological age from 173 months or 14 years and 5 months to 192 months or 16 years. The mental age ranged from 126 months or 10 years and 6 months to 202 months or 16 years and 10 months. The mean chronological

---

[1]Giles M. Ruch,and H. F. Popenoe, "Manual of Directions" Ruch-Popenoe General Science Test Form A and B, United States Office ofEducation, Washington, D. C.

age for Group B was 187.9 months or 15 years and 6 months. The mean mental age was 164 months or 13 years and 8 months.

TABLE 1

A FREQUENCY DISTRIBUTION BY SEX OF CHRONOLOGICAL AGES AND MENTAL AGES OF GROUP A AND GROUP B ON THE CALIFORNIA TEST OF MENTAL MATURITY ADVANCED SERIES

Field-Trip Group A				Textbook-Group B			
Pupils	Sex	C. A.	M. A.	Pupils	Sex	C. A.	M. A.
1	M	166	212	1	M	173	202
2	F	190	202	2	M	173	202
3	M	192	201	3	F	190	190
4	M	182	200	4	F	188	188
5	F	192	196	5	F	186	188
6	M	192	186	6	F	174	185
7	M	192	186	7	F	186	173
8	F	192	185	8	F	192	173
9	F	180	180	9	F	180	172
10	F	192	170	10	F	188	172
11	M	192	170	11	F	174	170
12	M	192	169	12	F	186	168
13	M	192	168	13	F	190	168
14	M	186	168	14	F	192	162
15	F	190	168	15	F	192	162
16	F	186	166	16	F	192	162
17	M	192	165	17	F	192	162
18	M	192	164	18	M	176	160
19	F	192	163	19	M	192	160
20	F	180	159	20	F	187	159
21	F	189	154	21	F	176	158
22	F	192	150	22	F	192	158
23	F	192	148	23	F	192	152
24	F	192	148	24	F	192	146
25	F	192	148	25	F	192	146
26	M	183	147	26	F	192	143
27	F	192	145	27	M	192	142
28	M	192	143	28	F	192	142
29	M	192	142	29	F	192	132
30	M	173	127	30	F	192	126
Mean		187.6	166.56			189.3	164.67

The data regarding intelligence quotients and achievement scores

made on the initial test which are descriptive of the pupils concerned in this study are presented in Table 2

TABLE 2

A FREQUENCY DISTRIBUTION OF SCORES OF INTELLIGENCE QUOTIENTS MADE ON INITIAL ACHIEVEMENT TEST OF THE RUCH-POPENOE GENERAL SCIENCE TEST FORM A FOR GROUP A AND GROUP B

Group A			Group B		
Pupils	I.Q. Scores	Achievement Scores	Pupils	I.Q. Scores	Achievement Scores
1	126	26	1	111	29
2	109	29	2	110	26
3	106	29	3	106	33
4	105	28	4	100	21
5	102	27	5	100	20
6	100	25	6	95	23
7	97	32	7	95	25
8	97	18	8	94	34
9	96	35	9	93	20
10	91	18	10	91	28
11	91	14	11	91	24
12	89	19	12	90	21
13	88	18	13	89	18
14	88	13	14	89	16
15	88	26	15	87	23
16	88	13	16	85	16
17	87	18	17	83	17
18	87	16	18	83	19
19	86	16	19	82	32
20	85	15	20	81	15
21	84	15	21	81	12
22	81	21	22	81	15
23	81	15	23	79	14
24	78	13	24	76	17
25	77	13	25	76	10
26	77	19	26	75	15
27	77	12	27	73	17
28	75	10	28	73	15
29	74	13	29	69	15
30	71	11	30	66	8
Mean	89.5	20.0		87.66	19.96

Group A ranged in intelligence quotients from 71 to 126. Group A ranged in achievement scores from 10 to 35.

Group B ranged in intelligence quotients from 66 to 111. Group B ranged achievement scores from 8 to 34.

The mean intelligence quotients score for Group A was 89.5 and in achievement the mean score was 20.0. The mean intelligence quotients score for Group B was 87.67 and in achievement the mean score was 19.96.

The data regarding the scores earned on the initial achievement test by boys and by girls within Group A and B are presented in Table 3.

TABLE 3

THE MEANS, DIFFERENCES IN THE MEANS, AND THE T VALUE FOR GROUPS A AND B, BOYS AND GIRLS

	A Boys	A Girls	B Boys	B Girls	A Boys	B Boys	A Girls	B Girls
Means	17.13	15.46	22.4	14.24	17.13	22.4	15.46	14.24
Diff. in Means	1.67		8.16		5.1		1.22	
t Value	0.828		2.262		0.999		0.611	

The mean score of boys of Group A was 17.13, and of girls of Group A was 15.46, a difference of means 1.67, the t value was 0.828, which was not significant at the 5 per cent level of confidence. The mean score of Group B was 22.4, and of girls of Group B was 14.24, the difference of means was 8.16, the t value was 2.262, which was significant at the 5 per cent level of confidence. The means score of boys of Group A was 17.13, and the mean score of boys of Group B was 22.4, a difference of 5.1, the t value was 0.999, which was not significant at the 5 per cent level of confidence. The means score of girls of Group A was 15.46, and for girls of Group B was 14.24, a difference of 1.22, the t value was 0.611, which was not significant at the 5 per cent level of confidence.

The combined data for chronological ages, mental age, intelligence quotients and the achievement scores on the initial test are presented in Table 4, page 20.

An analysis of Table 4 shows that the two groups were equal in chronological age. Group A mean chronological age was 189.6 months, and Group B mean age was 187.9. The standard deviation for Group A was 8.10 and for Group B the standard deviation was 7.0. The standard error for Group A was 1.52 and the standard error for Group B was 1.50. The difference in the means of the two groups was 1.7. The t value was 0.003 which was not significant at the 5 per cent level of confidence. Therefore, the two groups were equal in chronological age.

Group A mean mental age was 166.56 months and B mean mental age was 164.67 months. The standard deviation for Group A was 20.55 and for Group B the standard deviation was 20.50. The standard error for Group A was 3.9 and for Group B the standard error was 3.41. The difference in the means of the two groups was 0.11. The t value was 0.905, which was not significant at the 5 per cent level of confidence. Therefore, the two groups were equal in mental age.

The two groups were also equal in intelligence. Group A mean intelligence quotient was 89.5 and Group B mean intelligence quotient was 87.66. The standard deviation for Group A was 12.20 and for Group B it was 12.80. The standard error for Group A was 2.27 and for Group B it was 2.33. The difference in the means was 1.83. The t value was 0.085, which was not significant at the 5 per cent level of confidence.

The two groups were also equal in science achievement as shown by the

TABLE 4

THE MEANS, STANDARD DEVIATION, STANDARD ERROR OF THE MEANS, THE DIFFERENCES IN THE MEANS, AND THE T VALUE, OF THE CALIFORNIA TEST OF MENTAL MATURITY, ADVANCED SERIES, AND THE RUCH-POPENOE GENERAL SCIENCE TEST FORM A FOR GROUP A AND GROUP B

California Test of Mental Maturity Advanced Series							Ruch-Popenoe General Science Test Form A Achievement Test					
	C. A.		M. A.		I. Q.							
Groups	A	B	A	B	A	B	Part I A	B	Part II A	B	Total A	B
Means	189.6	187.9	166.56	164.67	89.5	87.66	14.6	14.2	4.67	6.77	20.0	19.96
S. D.	8.10	7.0	20.55	20.50	12.20	12.80	5.91	5.64	2.6	2.56	5.01	6.63
S. E.	1.52	1.50	3.9	3.41	2.27	2.33	1.09	1.03	.047	.048	1.12	1.23
D. M.	1.70		1.90		1.83		0.4		2.21		0.04	
t Value	0.003		0.905		0.085		0.023		2.13		0.21	

initial test. Group A mean score was 20.0 and Group B mean score was 19.96. The standard deviation for Group A was 5.01 and for Group B it was 6.63. The standard error for Group A was 1.12 and for Group B it was 1.23. The difference in the means was 0.04. The t value was 0.021 which was not significant at the 5 per cent level of confidence.

Table 3 showed the differences within the groups in terms of sex. The boys and girls of Group A were equal in achievement, with the boys possessing a slight advantage, but not significant at the 5 per cent level of confidence. The boys of Group A and the boys of Group B were equal with the boys of Group B possessing a slight advantage, but not significant at the 5 per cent level of confidence. The 5 boys of Group B appeared to excel the 25 girls of Group B having a difference in the means of 8.16, with a t value of 2.262 which was significant at the 5 per cent level of confidence. The girls of Group A were equal in achievement with the girls of Group B, with girls of Group A possessing a slight advantage, but not significant at the 5 per cent level of confidence.

The writer concluded that with the instruments used in this study that the subjects were equal in chronological age, mental age, intelligence quotients and in prior knowledge of science as they were equated for this experimentation. Since the two groups of subjects were equal, the chances for the acquisition of science knowledge taught by either method are equal, except for the slight difference that seem to exist between the 5 boys of Group B and the 25 girls of Group B. However, the fact that there were 15 boys in Group A, this superiority of the boys in Group B over the 25 girls of Group B would seem to balance this factor.

The Results on the Final Science Achievement Test.--The Ruch-Popenoe General Science Test for High School Form B was administered as the final science achievement test to the two groups under study at the end of the sixteenth week. These data are presented in Tables 5 and 6, accompanied by the appropriate statistical measures basic to their analysis and interpretation.

For Group A, Table 6 shows that on the final test of achievement, the thirty pupils in this group using the community resources materials as the basic materials for acquiring their science knowledge obtained scores in the following order: Part I of the test, the mean was 22.6, the standard deviation was 4.02, the standard error was 0.70.

For Group B, Table 6 shows that on the final test of achievement the thirty pupils in this group using the textbook, laboratory and classrooms sources for acquiring their science knowledge obtained scores in the following order: Part I of the test the mean was 26.9, the standard deviation was 5.38, the standard error was 1.0. The difference in the means of the two groups in Part I was 4.3. The t value was 2.48 in favor of Group B, this was significant at the 5 per cent level of confidence. Part I of the Ruch-Popenoe General Science Test, Form B measures the knowledge of scientific principles, concepts, terms, definitions, and applications.

Therefore, the writer concluded that the "textbook method" was superior to the "field-trip method" in teaching this aspect of General Science.

For Group A, Table 6 shows that on the final test of achievement the thirty pupils in this group obtained a mean score of 8.03 on Part II.

The standard deviation was 2.44, and the standard error was 0.45. The difference in the means of the two groups on Part II was 0.73. The t value was 0.093, which was not significant at the 5 per cent level of confidence. Part II measures the ability of pupils to identify apparatus, organisms, structures and principles, and to apply principles of science to the solution of simple problems. Therefore, we can conclude that neither of the two methods of teaching these aspects of general science is superior to the other.

For Group A, Table 6 shows that on the final test of achievement the thirty pupils in this group obtained a mean score of 31.51 on the total test. The standard deviation was 3.77, and the standard error was 1.13.

For Group B, Table 6 shows that on the final test of achievement the thirty pupils of this group obtained a mean score of 34.54 on the total test. The standard deviation was 6.21, the standard error was 1.12. The difference in the means of the two groups on the total of the test was 3.03. The t value was 2.34 which was significant at the 5 per cent level of confidence. Therefore, the writer can conclude that the "textbook method" was superior to the "field-trip method" in the teaching of those aspects of general science as measured by the Ruch-Popenoe General Science Test.

The data for comparison of the scores on the final achievement test Form B, for boys and girls within Group A, and for boys and girls within Group B, and for boys of Group A with boys of Group B and for girls of Group A with girls of Group B are presented in Table 7.

The standard deviation was 2.33, and the standard error was 0.43.

TABLE 5

A FREQUENCY DISTRIBUTION OF THE SCORES MADE ON THE FINAL ACHIEVEMENT TEST, THE RUCH-POPENOE GENERAL SCIENCE TEST FORM B AND THE MEANS FOR GROUPS A AND B

Pupils	Group A	Pupils	Group B
1	41	1	46
2	40	2	45
3	39	3	45
4	39	4	45
5	39	5	42
6	37	6	40
7	36	7	36
8	35	8	36
9	35	9	36
10	35	10	36
11	35	11	36
12	35	12	35
13	34	13	35
14	34	14	35
15	33	15	34
16	31	16	34
17	30	17	33
18	30	18	33
19	30	19	33
20	30	20	31
21	29	21	31
22	29	22	31
23	29	23	30
24	28	24	30
25	28	25	29
26	28	26	27
27	27	27	26
28	27	28	26
29	26	29	24
30	23	30	23
Mean	31.51		34.54

For Group B, Table 6 shows that on the final test of achievement the thirty pupils in this group obtained a mean score of 7.9 on Part II.

TABLE 6

THE MEANS, STANDARD DEVIATION, STANDARD ERROR OF THE MEANS, THE DIFFERENCE IN THE MEANS, AND THE T VALUE, OF THE RUCH-POPENOE GENERAL SCIENCE TEST FORM B, PARTS I AND II, AND TOTAL FOR GROUPS A AND B

	Part I		Part II		Total	
Groups	A	B	A	B	A	B
Means	22.6	26.9	8.63	7.9	31.51	34.54
Standard Deviation	4.02	5.38	2.33	2.44	3.77	6.21
Standard Error	0.70	1.0	0.43	0.45	1.13	1.16
Difference of Means	4.3		0.73		3.03	
t Value	2.48		0.93		2.34	

TABLE 7

THE MEANS, DIFFERENCE IN THE MEANS, AND THE T VALUE FOR GROUPS A AND B

	A Boys	A Girls	B Boys	B Girls	A Boys	B Boys	A Girls	B Girls
Means	22.29	19.26	34.8	19.12	22.29	34.8	19.26	19.12
Diff. in Means	3.03		15.68		12.51		0.14	
t Value	0.671		4.99		2.318		0.073	

The mean score of boys of Group A was 22.29, and of girls of Group A was 19.29, the difference in the means was 3.03, the t value was 0.671, which was not significant at the 5 per cent level of confidence. The mean score for boys of Group B was 34.8, and for girls of Group B was 19.12, the

difference in the means was 15.68, the t value was 2.318, which was significant at the 5 per cent level of confidence, in favor of the boys of Group B. It is to be noted, however, that the boys of Group B achieved significantly higher than the girls of the same group on the initial test. The mean score for the boys of Group A was 22.29, and for the boys of Group B it was 34.8, the difference in the means was 12.51, the t value was 2.318, which was significant at the 5 per cent level of confidence in favor of the boys of Group B. The mean score for the girls of Group A was 19.26, and for the girls of Group B it was 19.12, the difference in the means was 0.14, which was not significant at the 5 per cent level of confidence.

On the basis of the analysis and comparison of the achievement of the sex groups within Group A and Group B, it seems justificable to conclude that the differences in achievement cannot be attributed to sex.

CHAPTER III

SUMMARY AND CONCLUSIONS

Introductory Statement.--The problem involved the study of the effectiveness of two methods of teaching general science in the 10th grade, at the Athens High and Industrial School, Athens, Georgia. The methods were the "field-trip method" and the "textbook method."

The subjects were sixty high school pupils enrolled in the general science class in the Athens High and Industrial School taught by the writer. The sixty subjects were equal in chronological age, mental age and in intelligence. They were also equal in science knowledge as indicated by the scores earned on the initial science achievement test.

The purpose of this problem was to test by experimentation the null hypothesis there is no difference in the relative effectiveness in the teaching of general science by the "field-trip method" and by the "textbook method."

The sixty pupils were divided into two equal groups of 30 pupils each. The groups were designated as Group A, the experimental group, and Group B, the control group. The experimental group employed the "field-trip method" and the control group employed the "textbook method" of instruction.

The degree of scholastic achievement in general science of the sixty pupils at the beginning of the study was determined by the scores earned on the Ruch-Popenoe General Science Test for High School Form A, administered as the initial test. The scores revealed that the two groups were equal in science achievement. Group A taught by the "field-trip

method" earned a mean score of 20.0 and Group B taught by the "textbook method" earned a mean score of 19.96, the difference in the mean was 0.04; the t value was 0.021, which was not significant at the 5 per cent level of confidence. Therefore, the writer concluded that the two groups were equal in science achievement, and that the chances for acquiring science knowledge taught by either method--the "field trip method" or the "textbook method", for both groups were equal.

Summary of Findings.--The data of Table 6 shows that the two groups during the experimental period achieved in the following order:

1. In Part I of the Ruch-Popenoe General Science Test for High School Form B: For Group A the mean score was 22.6, and for Group B the mean score was 26.9; the difference in the means was 4.3, the t value was 2.48, which was significant at the 5 per cent level of confidence in favor of Group B. Therefore, the writer concluded, that the acquiring of science knowledge as measured by the Ruch-Popenoe General Science Test for High School Form B, when taught by the"textbook method" is superior to that taught by the "field-trip method," in the aspect of Part I.

2. In Part II of the Ruch-Popenoe General Science Test for High School Form B: For group A the mean score was 8.63, and for Group B the the mean score was 7.9, the difference in the means was 0.73, the t value was 0.095, which was not significant at the 5 per cent level of confidence. Therefore, the writer concluded that the acquiring of science knowledge as measured by the Ruch-Popenoe General Science Test for High School Form B, when taught by the "field-trip method" and the "textbook method" in this aspect of general science, neither method is superior to the other.

3. Total Part of the Ruch-Popenoe General Science Test for High School Form B: For Group A the mean score was 31.51, and for Group B the mean score was 34.54. The difference in the means was 3.03, the t value was 2.34 which was significant at the 5 per cent level of confidence in favor of Group B. Therefore, the writer concluded that the acquiring of science knowledge as measured by the Ruch-Popenoe General Science Test Form B, when taught by the "textbook method" is superior to that taught by the "field-trip method."

Further in the findings of this study the writer took under consideration the fact of sex influences and compared the results as to sex within the groups, and the sex of one group with the sex of the other group.

For the boys of Group A the mean score was 22.29, and the mean score of the girls of Group A was 19.26, the difference in the means was 2.03, the t value was 0.671, which was not significant at the 5 per cent level of confidence. Therefore, the writer concluded that with Group A there was no sex factor influencing the results.

For the boys of group B the mean score was 34.8, and for the Girls of Group B the mean score was 19.12, the difference in the means was 15.68, the t value was 4.99, which was significant at the 5 per cent level of confidence. It is to be noted that the boys of Group B scored significantly higher than the girls of the same group on the initial test. Therefore, it seems justifiable to conclude that the difference cannot be attributed to sex factors.

For the boys of Group A the mean was 22.29, and for the boys of Group B the mean score was 34.8, the difference was 12.51, the t value was 2.318, which was significant at the 5 per cent level of confidence.

Therefore, the writer concluded that whatever differences exist in the achievement of the two groups it seems justificable to isolate them from the sex factors.

The data summarizing the results of the three tests used in this study which included The California Test of Mental Maturity Advanced Series, and the Ruch-Popenoe General Science Tests Forms A and B, are presented in Table 8.

Conclusions.--The conclusions based upon the analysis of the principles theories, and research studies in references to the "field-trip method" and the "textbook method" follow:

Neither one of these methods "field-trip" nor the"textbook" is wholly wrong and the other wholly correct. Each has a place and a function in the educative process

The conclusion based upon the gathering, analyzing and interpretating of the data of the two groups of students to test the null hypothesis that there was no difference in the relative effectiveness of the methods, the "field-trip" and the "textbook," would warrant the assumption that the null hypothesis was invalidated.

The conclusion based upon the data analyzed and interpreted in the light of the sex factor seem to warrant that whatever difference exists is divorced from sex factors.

The superiority of the"textbook method" as revealed in this study does indicate the need for further experimentation in the effectiveness of the techniques involved, if a clear and distinct superiority of either method is to be established.

TABLE 8

THE MEANS, THE DIFFERENCE IN THE MEANS, AND THE T VALUE OF THE CALIFORNIA TEST OF MENTAL MATURITY, ADVANCED SERIES, AND THE RUCH-POPENOE GENERAL SCIENCE TEST FORMS A AND B FOR GROUPS A AND B

California Test of Mental Maturity, Advanced Series							Ruch-Popenoe General Science Test			
Groups Tests	C. A.		M. A.		I. Q.		Initial Test-Form A		Final Test-Form B	
Groups	A	B	A	B	A	B	A	B	A	B
Means	189.6	187.9	166.56	164.66	89.5	87.66	20.0	19.96	31.51	34.54
D. M.	1.7		1.90		1.83		0.4		3.03	
t Value	0.003		0.905		0.085		0.021		2.34	

BIBLIOGRAPHY

Books

Beauchamp, Wilbur L. Instruction In Science.(Washington, D. C., 1932), United States Government Printing Office.

Bining, Arthur, and Bining, David N. Teaching Social Studies in Secondary Schools. New York: McGraw-Hill Book Company, Inc., 1941.

Bossing, Nelson L. Progressive Methods of Teaching in Secondary Schools. Atlanta: Houghton Mifflin Co., 1942.

Dale, Edgar, Audio Visual Methods in Teaching. New York: Dryden Press Co., 1948.

Downing, Elliot Rowland. An Introduction to the Teaching of Science. Chicago: The University of Chicago Press, 1934.

Garrett, Henry E. Statistics in Psychology and Education. New York: Logan, Green and Company, 1933.

Goetting, M. L. Teaching in Secondary School. New York: Prentice-Hall Inc., 1942.

Good, Carter V., Barr, A. S., and Scates, Douglas E. The Methodology of Educational Research. New York: D. Appleton Century Co., 1941.

Guilford, J. P. Fundamental Statistics in Psychology and Education. New York: McGraw-Hill Book Co., 1950.

Hale, George Ellery. Beyond the Milky Way. New York: Charles Scribner's Son, 1926.

Heiss, E. D., Osbourn, E. S., and Hoffman, C. W. Modern Method and Materials for Teaching Science. New York: Mcmillan Co., 1940.

Linquist, E. F. Statistical Analysis in Educational Research. New York: Houghton Mifflin Co., 1940.

Moffatt, M. P. Social Studies Instruction. New York: Prentice-Hall Inc., 1950.

Rivlin, Harry N. Teaching Adolescents in Secondary School. New York: D. Appleton-Century Crofts, Inc., 1948.

Wesley, E. B. Teaching Social Studies in High School. New York: D. C. Heath Co., 1950.

Whitney, Frederick Lamson. The Elements of Research. New York: Prentice-Hall, Inc., 1950.

Articles

Aptaker, D. C. "Can Science be Taught Scientifically," School Science and Mathematics, XLIV (December, 1944), 823-830.

Dewey, John. "Method in Science Teaching," Science Education, XXIX (April, 1945), 11-123.

Mark, G. M. A. "Scientific Procedure as a Teaching Process," School Science and Mathematics, XLVII (June, 1947), 526-530.

Patthoff, E. F. "Use of Demonstration in Science Teaching," Science Education,XXIX (December, 1945), 253-255.

Sanders, Mary A. "Producing Curriculum Materials About the Community," Elementary School Journal, XXXIII (September, 1942), 601-605.

Richardson, A. G., and Smith, G. H. "Movies Versus Reading," The Clearing House, XXII (September, 1947), 199-123.

Unpublished Materials

Bailey, Aletha. "A Study of Two Methods of Teaching Typing in the Athens High School, Athens, Georgia." Unpublished M. A. Thesis, School of Education, University of Georgia, 1933.

Billue, Jebbie, Cecil. "A Study of Certain Performances of First Year College Students Who Elected to Take Physics and Chemistry, and Those that Did Not Elect to Take Physics and Chemistry in High School, University of Georgia, Athens, Georgia." Unpublished M. A. Thesis, School of Education, University of Georgia, 1950.

Curd, W. S. "The Value of Field Trips in the Teaching Secondary School Subjects." Unpublished M. A. Thesis, Colorado State Teachers College, 1925.

Edwards, Cecil Long. "An Experimental Study of the Two Methods of Science Teaching in the Seventh Grade at the W. H. Crogman Elementary School, Atlanta, Georgia." Unpublished M. A. Thesis, School of Education, Atlanta University, 1949.

Logan, Ora D. "A Study of Community Resources as Materials of Instruction in Social Studies in High Schools for Negroes in Atlanta, Georgia." Unpublished M.A. Thesis, School of Education, Atlanta University, 1945.

Martin, Jamie G. "A Study of Audio Visual Aids Versus Traditional Recitation Methods of Instruction at the W. H. Crogman Elementary School, Atlanta, Georgia." Unpublished M. A. Thesis, School of Education, Atlanta University, Atlanta, Georgia, 1950.

APPENDIX

MANUAL OF DIRECTIONS

CALIFORNIA TEST OF MENTAL MATURITY—ADVANCED SERIES

Devised by Elizabeth T. Sullivan, Willis W. Clark, and Ernest W. Tiegs

CONTENTS

THE AUTHORS

ELIZABETH T. SULLIVAN, Ph.D (Columbia). Formerly: Senior Educational Psychologist, Los Angeles County Schools; Lecturer in Psychology, University College, The University of Southern California; Supervisor, Department of Psychology and Educational Research, Los Angeles City Schools; Lecturer in Psychology, University of California Extension Division, Los Angeles. Author of numerous articles in educational and clinical psychology.

WILLIS W. CLARK, Ed.D. (Southern California). Research and Guidance Consultant, Los Angeles, California. Formerly Director of Research and Guidance, Los Angeles County Schools. Author and co-author of numerous research studies and such standardized tests as **Ingraham-Clark Diagnostic Reading Tests, Los Angeles Diagnostic Tests, Progressive Achievement Tests**, and **California Test of Personality.**

ERNEST W. TIEGS, Ph.D. (Minnesota). Editor-in-Chief, California Test Bureau. Formerly: Dean of University College and Professor of Education, The University of Southern California; Assistant to the Superintendent of Schools, Minneapolis, Minnesota. Author of such works as **Tests and Measurements for Teachers; Tests and Measurements in the Improvement of Learning**; co-author of **Progressive Achievement Tests** and **California Test of Personality.**

I. Purpose of the Test

This is a diagnostic test of mental maturity, devised for use with students in senior high school and college, and with adults. It contains material of sufficient range and diversity to indicate the degree of maturity in relation to the major factors involved in intellectual capacity, as well as a general measurement of mental maturity. Some of the significant features of this test are as follows:

1. Its primary purpose is to make for each person a diagnostic evaluation of those mental abilities which are related to, or determine, his success in various types of school activity, in order that the teacher may utilize this information directly in aiding students who have learning difficulties. It is similarly useful in personnel work.

2. It provides a diagnostic profile designed to show graphically the relative extent to which each person possesses these abilities, thus enabling the user to see at a glance the probable sources of difficulty or success and to provide to the maximum the guidance which such a profile may suggest.

3. It is based upon the philosophy, researches, and important inferences of outstanding leaders in the mental measurement field, as well as the work of the authors. The analytical comparison of the various sections of the test indicates a definite central factor, yet the same analysis reveals a specificity for each sub-test which is sufficient to justify its inclusion as a measure of a more or less unique factor.

4. Although primarily diagnostic and analytical, this test of mental maturity also yields not one, but three mental ages (M.A.'s) and intelligence quotients (I.Q.'s)—a non-language M. A. and I. Q., a language M.A. and I.Q., and the M.A. and I. Q. characteristic of the familiar intelligence test. The latter M.A. and I.Q. may be used for comparisons with the results of other intelligence tests.

II. Nature of the Test

This series of tests is unique in that each battery is preceded by tests of visual acuity, auditory acuity, and motor coordination, the purpose of which is to detect students with defects sufficiently serious to prevent obtaining a valid diagnosis of mental maturity with the remainder of the test.

In general, this test samples the maturity of memory (immediate and delayed); of apperceptive processes; of spatial relationships; and of the logical and mathematical aspects of reasoning. Certain tests are presented in verbal and others in non-language form in order to obtain a separate evaluation of each of these aspects of mental maturity.

Each battery is thus built upon a plan which (1) takes into account recognized mental processes or functions, and (2) corresponds with present knowledge of the nature of mental growth and development.

III. Reliability

Needless to say, the number and variety of test situations assures a high reliability. The test data for 400 pupils in grades 9 to 12 and 450 college students and adults have been analyzed and reliability coefficients have been computed by the split-halves method and corrected by the Spearman-Brown formula. The reliabilities of the Total Mental Factors score and the major test sections are as follows:

	Grades					
	9	10	11	12	Col.	Adult
Total Mental Factors	.949	.950	.946	.970	.942	.964
Language Factors	.913	.934	.933	.944	.925	.940
Non-Language Factors	.931	.949	.891	.917	.915	.938
Test A. Memory	.920	.929	.885	.914	.905	.924
Test B. Spatial Rel.	.871	.879	.903	.905	.887	.897
Test C. Logical Reasoning	.887	.879	.891	.903	.896	.903
Test D. Numerical Reas.	.901	.897	.912	.920	.904	.926
Test E. Vocabulary	.886	.897	.915	.927	.919	.927
No. of Cases	100	100	100	100	200	250
S.D. (M. A. in Mo.)	17.5	18.0	20.0	20.0	18.0	30.0

The probable error of estimate for an individual score varies from three months of mental age when the reliabilities for single grade are .95 and above to five months when the reliabilities are .87 to .89.

IV. Validity

The validity of any mental test is difficult to establish; there are no purely objective criteria or standards which correspond to the factors or abilities in terms of which conceptions of mentality are currently described.

The authors of these tests believe that the multiple factor theory of intelligence comes nearer to explaining observable phenomena than does the strong central-factor theory alone. They recognize the importance of philosophical contributions, but they believe that progress in determining the nature of mentality and the value of tests of mental maturity is dependent largely upon further studies in factor analysis which employ analytical and statistical techniques.* This series of tests recognizes contributions already made by including samplings of memory, verbal and mathematical abilities, spatial relations, and logic. The existence of all of these as relatively independent and distinct factors is gaining acceptance. The traditional method of correlating the results of this battery with the averages of several other intelligence tests (protecting results by observing the usual cautions regarding sampling and other statistical safeguards) reveals that the general or Total Mental Factors I.Q.'s obtained with this test may be used for comparative purposes with other intelligence tests. (The correlation of data obtained by use of *California Test of Mental Maturity* with individual *Stanford-Binet* M.A.'s and I.Q.'s [r = .88] is about as high as retests by use of the individual scale.) However, the practice of dealing only with mental ages and intelligence quotients obscures and ignores the separate important factors which constitute mentality; and it is in terms of these factors that the abilities of individuals should be diagnosed. This battery attempts such a diagnosis on the basis of present knowledge; further evidence of validity must await further knowledge of the nature of mental maturity.

V. Standards

Norms appear on the last pages of this Manual. These norms are comparable to those regularly obtained by use of individual psychological examinations and well-standardized group tests and are based on over 25,000 cases. The standard deviation of I.Q.'s for the normal or typical population is 16. (See also page 19.)

The profile on the front page of each test booklet provides for a graphic representation of the responses in relation to a Mental Age scale. The Summary of Data provides ready reference to the customary mental ages and intelligence quotients.

In addition, percentile norms are provided for ages 12, 13, 14, 15, and 16 (incl. Adults). These percentile norms are given on pages 17 and 18 of this Manual.

*Guilford, J. P., **Psychometric Methods**, McGraw-Hill, 1936.

Kelly, Truman L.: **Crossroads in the Mind of Man**, Stanford Univ. Press, 1928; also **Essential Traits of Mental Life**, Harvard Univ. Press, 1935.

Spearman, C.: **Pitfalls in the Use of Probable Errors**, Jr. of Educ. Psy., Vol. 23, No. 7; also a series of five articles on **The Factor Theory and Its Troubles**, in Jr. of Educ. Psy., Vol. 24, Nos. 7 and 8; and Vol. 25, Nos. 2, 4, and 5.

Thurstone, L. L.: **The Theory of Multiple Factors**, and **A Simplified Multiple Factor Theory**, University of Chicago Book Store, 1933; also **The Vectors of Mind**, University of Chicago Press, 1935.

Tryon, Robert C.: **Multiple Factors vs. Two Factors as Determiners of Abilities**, Psy. Rev., Vol. 39, No. 4.

Thomson, G. H.: **The Factorial Analysis of Human Ability**, Houghton Mifflin Co., 1939.

CLASS RECORD SHEET for use with CALIFORNIA TEST OF MENTAL MATURITY

SERIES USED { Preprimary ..... Primary ..... Elementary ..... Intermediate ..... Advanced .....
Preprimary S.F. ..... Primary S.F. ..... Elementary S.F. ..... Intermediate S.F. ..... Advanced S.F. .....

School ..... Date Given ..... 19 .....

City ..... Grade ..... Teacher .....

PUPIL'S NAME	SEX	C.A.	M. A.			I. Q.			PERCENTILE RANK FOR AGE							
			TOTAL MENTAL	F. LANG-UAGE	G. NON LANG-UAGE	TOTAL MENTAL	F. LANG-UAGE	G. NON LANG-UAGE	A. MEMORY	B. SPATIAL RELATION-SHIP	C. LOGICAL REASON-ING	D. NUMERICAL REASON-ING	E. VOCAB-ULARY	TOTAL MENTAL	F. LANG-UAGE	G. NON LANG-UAGE
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																
13																
14																
15																
16																
17																
18																
19																
20																
21																
22																
23																
24																
25																
26																
27																
28																
29																
30																
31																
32																
33																
34																
35																
36																

SUMMARY OF DATA

INTELLIGENCE QUOTIENTS:

ITEM	BELOW 50	50 TO 54	55 TO 59	60 TO 64	65 TO 69	70 TO 74	75 TO 79	80 TO 84	85 TO 89	90 TO 94	95 TO 99	100 TO 104	105 TO 109	110 TO 114	115 TO 119	120 TO 124	125 TO 129	130 TO 134	135 TO 139	140 TO 144	145 TO 149	150 and Above	NUMBER CASES	MEDIAN I. Q.
TOTAL MENTAL																								
F. LANGUAGE																								
G. NON-LANGUAGE																								

MENTAL AGES:

ITEM	BELOW 24	24 TO 35	36 TO 47	48 TO 59	60 TO 71	72 TO 83	84 TO 95	96 TO 107	108 TO 119	120 TO 131	132 TO 143	144 TO 155	156 TO 167	168 TO 179	180 TO 191	192 TO 203	204 TO 215	216 TO 227	228 TO 239	240 TO 251	252 TO 263	264 TO 275	276 TO 287	288 TO 299	300 and Above	NUMBER CASES	MEDIAN M. A.
TOTAL MENTAL																											
F. LANGUAGE																											
G. NON-LANGUAGE																											

PERCENTILE RANK:

SECTION	TEST	1	5	10	20	30	40	50	60	70	80	90	95	99	TOTAL CASES	MEDIAN	NORM	DIFF. + OR -
A	MEMORY																50	
B	SPATIAL RELATIONSHIPS																50	
C	LOGICAL REASONING																50	
D	NUMERICAL REASONING																50	
E	VOCABULARY																50	
F. TOTAL MENTAL																	50	
F. LANGUAGE																	50	
G. NON-LANGUAGE																	50	

Published by California Test Bureau 5916 Hollywood Boulevard, Los Angeles 28, California

VI. Description of the Pre-tests

Test 1. Visual Acuity.

The purpose of this test is to discover whether examinees can see well enough to take the remaining tests with fairness to themselves. The simple method of testing vision offered here is applicable to group testing under ordinary school room, office, or factory conditions. It is not a visual examination in any sense of the word; it is merely a quick, efficient manner of detecting persons with gross defects which would prevent a fair measurement of mental maturity.

Any person who can read lines 7 or 8 without error, or with errors probably due to pure chance, should have no visual difficulty with the remainder of the test. Those who cannot read lines 7 and 8 should be referred to a nurse or medical examiner for further visual examination. Where a low score on the total test is apparently due to visual difficulty, the test should be repeated as an individual examination with the examiner assisting the student or worker by clarifying the tasks.

The examiner should watch the posture and attitudes of the persons taking the test to see whether any are frowning, squinting, or holding their heads too close to their papers. An individual may be suffering from eye strain due to particular eye defects, and yet make a good score on this test.

Teachers or medical examiners can apply individual visual tests if equipment is available, thus supplementing the rougher measure offered in the above group test. Individuals with defective vision may thus be discovered and favored, students in the location of their seats with reference to the blackboard, and both students and workers with respect to the distance from windows where brighter illumination is usually an advantage to them. For further informal measurement Snellen's Vision Chart, and Bausch and Lomb Optical Company's Test Chart are widely used. Some schools are utilizing such devices as Betts Ready-to-Read Tests and the American Optical Company's Ophthalmo-graph.

Test 2. Auditory Acuity.

The purpose of this test is to discover whether individuals hear well enough what is said to them in an ordinary tone of voice and under ordinary school-room, office, or factory conditions to take the remaining tests without disadvantage to themselves.

This is not a measure of how well persons hear in general; it is rather a measure of whether these particular individuals can hear directions under the conditions which prevail in the given situation. For this purpose, the authors use simple facts of every day experience, and thereby produce a situation in which differences in ability to hear constitute the major variable. Individuals with a language difficulty, those whose readiest language is other than English, obviously are under an additional handicap in taking this test. The correct marking of a familiar picture is an indication that the directions were correctly heard. In the case of words very similar in sound, correct marking indicates that minor differences also are distinguished. Where individuals obtain scores of less than ten on this pre-test (except an occasional case due to pure chance), and the scores on the test proper give evidence of confusion due to lack of hearing ability, the test should be repeated as an individual examination.

Inadequacies in hearing are difficult to detect even with the aid of special equipment. Because of the number of factors which enter into the testing of hearing, it is important to have the opinion of a skilled examiner working under normal conditions for any student who gives definite evidence of hearing difficulty. Generally speaking, persons who tend to be inattentive, who take listening attitudes, or who have imperfections in speech should be suspected of having impaired hearing. All such individuals should be given an individual test of hearing at frequent intervals with the aid of such devices as a McCallie or a Western Electric audiometer.

Test 3. Motor Coordination.

The purpose of this test is to determine the degree of motor coordination which the student or worker possesses. The movement is continuous, alternating from right to left along horizontal, vertical, and oblique paths, involving movement toward the body and away from it. The time is controlled by counting. Under these conditions, individual performance is significant and revealing. Low scores may be due to poor vision (compare with results of Test 1), immaturity, inadequate spatial orientation (compare with results of Tests 6, 7, and 8), speed unfavorable for the individual, or unsteadiness produced by emotional strain.

An analytical study of the results of this test will provide evidence concerning the relative physical development and the nervous control of the individual. Those persons who show emotional "blocking" and inadequate motor control should be tested individually on the remainder of the test, making allowances for these disabilities.

If the individual does well on the remainder of the test in spite of a low score on motor coordination, he will probably need special assistance in

writing, drawing, and similar activities in business and industry where some degree of muscular control is involved. Those who score high on this test should be expected to do well in writing, drawing, and similar activities.

VII. Description of Mental Maturity Tests

Test 4. Memory (Immediate Recall).

This is a test of auditory verbal memory. Short series of words arranged in pairs, logically or illogically associated, are pronounced, preceded by the information that the memory for this material is to be tested. It is, therefore, a test of ability which is basic to learning. As the series increases in number the length of the immediate memory span for auditory verbal impressions is revealed. The response is non-verbal in type, the response word being represented pictorially in a multiple-choice situation. No part of the test is dependent on the ability to read.

Test 5. Memory (Delayed Recall) (given after Test 13).

This is a test of auditory verbal memory of the intentional learning type. Examinees listen to a story read to them just preceding Test 14 with the knowledge that they will be examined later. After an interval of about 30 minutes, they are given the opportunity to respond to a series of multiple choice test situations.

Those who make low scores on Test 5, whether or not they score high on Test 4, will be likely to experience serious difficulties in several areas, unless such low scores can be accounted for by defective vision or hearing, or both. Such persons frequently have a reading disability; memory is basic, not only in the reading act itself, but in using the results of reading. Such persons may also prove to be poor spellers; they may find music difficult because they cannot recall the meanings of notation, signatures, and tempo; they may dislike to participate in plays and dramatization because they cannot learn or retain their lines; and they may do poor work in the social studies, and in business and industry, where the recall of names, dates, places, and events is involved in the understanding of cause and effect relationships.

On the other hand, where vision, hearing, and memory scores are satisfactory or high, these types of difficulties should not appear. Individuals with good memory ability usually do well in the traditional subject-matter centered school; but they usually have difficulty in such schools if they score low on Tests 4 and 5. In general, individuals who score low on memory tests must rely on notes, textbooks, and other sources to provide the facts and information which they need, but cannot recall, in the pursuit of other types of educational or business and industrial activities.

Ability to remember does not necessarily carry with it ability to make inferences, to generalize, or to reach valid conclusions. These are higher mental processes which will be discussed later.

Tests 6, 7, and 8. Spatial Relationships.

These three tests are designed to measure the status of certain aspects of thinking which involve orientation in space and the use of spatial relationships.

Test 6 reveals the individual's ability to orient himself in many complex situations involving the discrimination between right and left; Test 7 detects ability to use spatial imagery in manipulating spatial patterns in many different forms and positions; and Test 8 identifies foresight in dealing with problems involving other complicated spatial situations.

In addition to their use in critical thinking, space concepts and relationships are used in simpler form in many of the daily educational and work activities of individuals.

Global geography introduces new spatial concepts in addition to those previously required in dealing with maps, charts, and graphs. Writing, spelling, and drawing all involve space orientation. Plays and dramatizations involve space orientation with respect to the audience as well as to other players. Typewriting involves orientation of hands and fingers with respect to the keyboard. Playing an organ involves the simultaneous space orientation and unified functioning of both hands and both feet. Even relatively simple tasks in the home economics kitchen often involve simultaneous space orientation to a number of factors, including the shape and size of the room, the equipment, the materials, and the operations.

A high score in these tests indicates ability to do well in the activities described above as well as to solve problems involving somewhat more intricate spatial relationships. Such persons should be able to give as well as follow directions; and they should do well in planning, layout, design, and construction.

A low score in these tests may be due to poor perception or memory, or both; if these two factors are unsatisfactory, the individual will need assistance in tasks involving space orientation and relationships. However, if the unsatisfactory status is due to lack of opportunity rather than ability, it may be improved through such assistance. The teacher (or foreman) must be particularly careful in giving directions to such persons because they often find

it difficult both to understand and to follow the many directions involving spatial relationships.

Tests 9, 10, 11, and 15. Logical Reasoning.

The four tests in this group represent some of the higher forms of intellectual activity which are usually designated as thinking or reasoning. Ability to think depends for effectiveness upon perception and memory functioning in both spatial and non-spatial situations, as well as upon the abilities involved in sensing differences, likenesses, and analogies, and in making inferences.

Tests 9, 10, and 11 are presented in graphic or non-language form; Test 15, inference or judgment, is presented in language form.

The simpler elements of logical reasoning are involved in most educational as well as other activities. The mere identification of likenesses and differences in the meaning or appearance of words in reading and spelling; reading, obtaining meaning from the printed page, or the understanding of speech; or the tryout and evaluation of a new color combination in elementary painting are examples. In general, no matter how simple the situation, wherever a problem requiring a decision or a choice of responses presents itself, the simpler aspects of logical reasoning function.

However, ability in logical reasoning develops from these simple beginnings through relatively simple and more complex problems of daily living to the critical thinking or reasoning involved in finding cures for insidious diseases, inventing radar, and perfecting instruments for defense or transportation.

As the individual matures, his school activities should provide problems and situations which develop his powers of logical reasoning. He should become increasingly able to detect and use finer shades of meaning in reading and speech, to distinguish outward appearances from actualities in political and social problems, and to make more valid analyses and inferences in situations or problems involving cause and effect relationships in social studies, science, and everyday living.

Those who obtain high scores on Tests 9, 10, and 11, and low scores on Test 15 may lack reading or memory ability. Tests 5 and 16 should be checked in this connection.

When inability to reason logically is due to a remediable cause such as a very unfavorable environment over a period of years, the individual can be aided in improving his reasoning ability. However, where the environment has been favorable and he has had the commonly available opportunities, a low score usually indicates an actual lack of capacity.

Such a person can neither perceive the fine distinctions of subtle and complex cause and effect relationships, nor can he plan or execute attacks on problems which require careful observation, discriminating analysis, the making of inferences, the projection of possible answers or solutions, and the ability to reach valid conclusions. Such individuals must be content to live on a relatively low intellectual plane; lacking facility in inference and generalization, they must be given principles and generalizations as facts, rather than attaining them as end products of logical reasoning; they must live in a concrete rather than an ideational world. However, this does not prevent them from becoming very skillful in such fields as music or the graphic arts. They should be tested for specific aptitudes and interests.

On the other hand, an individual whose score reveals high logical reasoning ability should be expected to grow in the functional elements outlined above. He should be expected to recognize the nature and implications of problems; to distinguish between evidence and propaganda; to project and test possible solutions; and to reach valid conclusions.

Tests 12, 13, and 14. Numerical Reasoning.

Many factors analysis studies have yielded a more or less independent factor of intelligence variously called number factor, number facility, or numerical reasoning.

This ability involves the recognition and use of likenesses, differences, and analogies, and the making of inferences with special respect to quantitative or number situations and problems.

Individuals who score high on these tests should do good thinking in arithmetic, the mathematical phases of shop work, the numerical phases of home economics having to do with recipes, proportions, and patterns, and the arithmetical problems of everyday life, involving expenses, income, bookkeeping, making change, and the like.

If individuals who make low scores have not been denied the usual opportunities for developing this ability, such low scores suggest a deficiency in this factor of intelligence. They need special help in developing number concepts and in using the fundamental arithmetical processes involved in solving numerical problems. They frequently lack an appreciation of the significance or value of money; they must frequently be assisted in relating income to prices and expenses; much that is quantitative in their environment escapes them; and they lack definiteness and preciseness in their relations with others.

On the other hand, they may think well in the qualitative and emotional aspects of literature, music, and art, and do well in creative work which requires little or no numerical reasoning.

Test 16. Vocabulary.

Because of the lack of a better designation which is at the same time widely understood, Test 16 is called Vocabulary. However, this term signifies much more than mere connections between symbols and the realities for which they stand.

Ideas and meanings begin as perceptions which enter consciousness through the senses; if they are remembered, they may function in many relationships, spatial or non-spatial in nature, and they may be enriched and refined through use in logical and numerical situations. They finally emerge as concepts which are useful in thinking.

This verbal factor, called Vocabulary, is recognized as an important and relatively independent functional element of mental maturity.

Individuals who score high in this test possess the capacity to understand and profit from their experiences. They should do well in reading, literature, and drama which involve the understanding of symbols and the interpretation and projection of meanings through spoken and written language. They possess some of the basic abilities involved in understanding others and making others understand them. They should do well in managerial and executive positions.

However, a low or average score on this test is not proof of lack of capacity in the verbal factor; such a score may be due to lack of a favoring environment or training in the skills associated with this ability. Further study of the results of previous tests in this series is indicated. Individuals who score low on this test will profit less by reading, at least temporarily, than from other non-verbal types of educational activities.

VIII. Using the Test Results

General Considerations

The proper interpretation of test scores of an instrument such as the *California Test of Mental Maturity* requires the use of norms or standards. Thus, scores are interpreted as Mental Ages, so that the person may be said to have the mental ability equal to that of a typical person of a given age. The Intelligence Quotient (I.Q.) is the ratio of mental age to actual age and indicates the extent to which a given individual has mental ability above or below the average for his age.

Mental Ages are used as criteria of the level of ability at a given time. In both industrial relations and educational situations, the mental age requirements of given occupations or assignments are often known. Thus, it is possible to relate the ability of an individual to duties or assignments which are appropriate to his mental abilities.

Intelligence Quotient (I.Q.), being a ratio, and fairly constant, indicates the degree of ability that the individual has in comparison with others of his age. It is a convenient measure for use in considering the relative ability of a person in relation to the average (indicated by I.Q. 100). In the case of children under the age 16 it also provides a convenient means for determining the probable mental age at any given time. The actual, or chronological, age of any person (using 16 years in the case of those over 16) may be multiplied by the I.Q. to determine the estimated mental age at any time. I.Q.'s are ordinarily interpreted[1] about as follows:

I. Q.	*Descriptive Classification*	*Per Cent of Typical Population Included*
130 & above	Very superior	3%
115-129	Superior	12%
100-114	High average	35%
85- 99	Low average	35%
70- 84	Inferior	12%
Below 70	Very inferior	3%

In general, the higher the score, mental age, or intelligence quotient, the more complex, abstract, and difficult the task or problem which an individual can handle. Mental ability is one of the most significant factors which must be given attention in education and in occupational adjustment. Frequently, the degree of intelligence is the controlling factor in success.

However, measures of capacity or intelligence should never be used alone, but should be considered in relation to other factors. One should not attempt to predict individual achievement from mental test data alone any more than one would attempt to judge an automobile on the basis of a single measure, such as height, weight, or length.

Language and Non-Language Data

As previously stated, one of the significant features of the *California Test of Mental Maturity* is that it provides Language M. A.'s and I. Q.'s and Non-Language M.A.'s and I.Q.'s as well as the customary total M.A.'s and I.Q.'s.

The *language test data* are particularly useful in indicating how well the individual understands relationships expressed in words, such as instructions, conference discussions, statements of logical principles or courses of action, and the like.

The *non-language test data* indicates how well the individual understands relationships among things or objects when language is not involved, such as physical or mechanical relationships.

[1] The above distributions and percentages apply only to those tests such as the California Test of Mental Maturity and California Capacity Questionnaire which have provided for a normal, rather than skewed, distribution of mental ages and I.Q.'s. They would not apply in the case of several intelligence tests which have arbitrarily allotted certain scores to higher mental ages without consideration of the normal probability curve, or which do not have a standard deviation of 16 points for a normal distribution of I. Q.'s.

There are significant differences in individuals between these two kinds of mental ability. It is not unusual for a person to have a language I.Q. of 70 or 80 and to have a non-language I.Q. above 100. Similarly, the reverse is frequently the case. Thus, the provision of both language and non-language measures affords greater insight into the mental processes of a given individual than is provided by the typical intelligence test. The significance of these additional data for guidance, selection, and placement is obvious in that they will make possible a more appropriate consideration of the real abilities of a person.

Mental Factors Data

A detailed description of the nature, purpose, and significance of mental tests included in the *California Test of Mental Maturity* is given in Sec. VII of this Manual. The tests are classified as Memory, Spatial Relationships, Logical Reasoning, Numerical Reasoning, and Vocabulary. Many specific suggestions regarding their interpretation are included in these descriptive statements, and it is recommended that the Section be carefully read by those who desire to obtain the maximum diagnostic value from the test data.

The percentile norms provided on pages 17 and 18 of this Manual are useful in educational diagnosis, vocational guidance, and employee selection and placement. These norms indicate for each individual his relative rank in comparison with others of his age group in the various mental factors.

Other Educational Uses

The use of measures of mental capacity is accepted in most school systems as an essential element in the counseling and guidance program, and as information basic to fitting instruction to the needs of each student. The Mental Ages obtained by use of the *California Test of Mental Maturity* are comparable to those obtained by most other intelligence tests. In addition, the (1) language mental ages and I.Q.'s and the (2) non-language mental ages and I.Q.'s provide diagnostic information which shows the extent to which the individual can think clearly when dealing with (1) word symbols, or (2) non-verbal situations. The separate factors data, as indicated above and in Section VII, are further aids in diagnosis.

The following are suggestions for use of M.A.'s and I.Q.'s in individual guidance:

1. To evaluate or predict the achievement of an individual in academic subjects: Compare the mental age (or Intelligence Grade Placement) and the educational age (or subject grade placement). Achievement should tend to approximate the mental age of the individual.

2. To obtain data fundamental to vocational guidance: Reference should be made to suggestions given regarding personnel selection on page 8 of this Manual.

Comparison of Intelligence and Achievement Test Medians

Intelligence quotients and intelligence grade placements are very useful in the following connections:

1. To determine if a class (or school) has made satisfactory progress in basic skills.

The following table is based upon over 100 school surveys and 48,000 individual measurements. This table is presented to show the range of median intelligence quotients, median intelligence grade placements (mental ages in terms of school grades—see next to last column of Norms on the last page of this Manual), and median achievements in the essential skills as determined by these surveys.

I.Q.'s AND RELATED DATA AS SHOWN BY SCHOOL SURVEYS

(Fraction of School Year above or below norm)

Class and School Medians

Percentile Rank	Intelligence Quotient	Intelligence Grade Placement	Reading Vocabulary	Reading Comprehension	Arithmetic Reasoning	Arithmetic Fundamentals	Language
99	114	+.94	+ .94	+ .90	+ .93	+1.08	+ .93
95	110	+.74	+ .72	+ .81	+ .60	+ .85	+ .76
90	108	+.61	+ .46	+ .62	+ .42	+ .70	+ .56
80	105	+.37	+ .30	+ .38	+ .29	+ .43	+ .35
70	103	+.26	+ .20	+ .18	+ .18	+ .27	+ .21
60	101	+.13	+ .10	+ .08	+ .09	+ .13	+ .10
50	100	.00	.00	.00	.00	.00	.00
40	98	—.10	— .09	— .16	— .17	— .07	— .12
30	96	—.18	— .16	— .29	— .34	— .20	— .21
20	94	—.27	— .33	— .40	— .59	— .39	— .34
10	89	—.50	— .53	— .60	— .87	— .57	— .54
5	85	—.60	— .62	— .79	—1.02	— .70	— .67
1	75	—.88	—1.38	—1.83	—2.52	— .79	—1.36

The data are given in percentiles and show the fractions of a school year above (+) or below (—) test norms for the subjects reported.

Thus, if the median I.Q. for a class (or school) is 105, such class (or school) is at the 80 percentile in intelligence when compared with the sampling of 48,000 cases measured. Such a class (or school) should normally be expected to have a median reading vocabulary score which is .30 of a year above normal, a median arithmetic fundamentals score which is .43 of a year above normal, etc. On the other hand, if the median I.Q. is below 100, the scores in basic skills will usually drop below the normal grade placement scores for average I.Q.'s. Thus, if the median I.Q. for a class (or school) is 94, reading comprehension scores .40 below normal grade placement scores for that class (or school) would be considerd satisfactory.

2. To set a suitable standard of achievement for a class (or school): Determine the median I.Q. and add (or subtract) the appropriate grade placement fraction to (or from) the grade placement of the class (or school) tested. These data, however, should indicate the need for differentiated standards in directing the educational program and in evaluating the accomplishment of the schools and classroom groups.

In using mental age or the intelligence quotient in

a given age or grade group, the following considerations should be kept in mind: The correlation or relationship between measurements of intelligence and academic success is far from perfect; in some subjects it is only 25 or 30 per cent better than chance. Although students with higher I.Q.'s will, in general, do better than those with lower I.Q.'s, if they are about the same age, the teacher should always remember that other factors such as health, previously learned study habits, opportunity, persistence, encouragement, and the like, play a large part in achievement.

It is particularly important in directing the learning of those having difficulty that teachers inspect the records for previous academic success in both language and non-language work, and obtain as many other types of pertinent information as possible in order that it may be used, together with the intelligence test data, and the diagnostic analysis of mental factors, in improving learning.[1]

Business and Industrial Uses.

Employment managers are concerned with both pre-service and in-service personnel. The *California Test of Mental Maturity* contributes significant information related to employee selection, employee placement, and employee adjustment.

When intelligence test data are used in employee selection and management, it is frequently more important to know the minimum intelligence requirements for a given job than to know the average ability of those engaged in it. In other words, it is often easier to predict failures than successes by use of intelligence test data. It is desirable to establish a *critical score, M.A., I.Q., or classification* which will permit the inclusion of the greatest possible percentage of satisfactory applicants and the elimination of the greatest possible percentage of unsatisfactory applicants.

In addition to the establishment of "critical" low scores, much attention is now being given to determining the range of mental ability which appears to be appropriate to various job classifications.

1. Employee Selection. In general, the more difficult the task, the higher the capacity required. As previously implied, routine tasks or types of work are better done by employees of lower I.Q.'s because more intelligent employees are apt to become discontented. Since such instruments as the *California Test of Mental Maturity* have been in use in vocational guidance and employment maangement, it has been found that successful functioning in typical positions requires minimum mental capacity (see classification on page 6) about as follows:

a. *Very Superior Ability.* In general, very superior ability is required in those persons who are engaged in the highest quality of creative or directive activity, such as: President or general manager of large manufacturing concern, lawyer, engineer with planning and managerial responsibilities of an involved nature, head of large bank, expert chemist, inventive genius, high-class journalist, judge, manager of large mercantile enterprise, physician or surgeon, research director, applied scientist, and statistician who utilizes advanced mathematical techniques.

b. *Superior Ability.* In general, superior ability required in those persons who must exercise excellent judgment and arrive at logical conclusions regarding a course of action in fairly complicated and involved situations, such as: Accountant, auditor, advertising expert who plans copy, banking official, stockbroker, dentist, machinery designer, druggist, employment manager, electrical engineer, geologist, inventor of commercial appliances, typical lawyer, manager or superintendent of an average sized factory, wholesale merchant, army officer, ship officer, insurance company official, clergyman, newspaper reporter, private secretary to business or professional man, social work supervisor, teacher, veterinary doctor, and author of magazine articles.

c. *High Average Ability.* In general, high average ability is required in those persons dealing with technical supervision, abstract classifications and details, and the carrying out of previously arranged plans such as: Shop foreman, illustrator, express agent, appraiser, aviator, bank teller, bookkeeper, building contractor, department store buyer, caterer, railroad clerk, shipping clerk, census compiler, railway conductor, designer, detective, draftsman, locomotive engineer, marine engineer, minor executive, small factory foreman, hotel keeper, inspector, insurance agent, interior decorator, institution manager, librarian, smaller manufacturer, master mechanic, nurse, minor government official and inspector, photo engraver, photographer, printer, probation officer, retail dealer in such business as clothing, drugs, hardware, and the like, automobile salesman, stock and bond salesman, traveling salesman, social worker, statistical clerk, stenographer, art teacher, elementary teacher, telegraph operator, undertaker, and Y.M.C.A. secretary.

d. *Low Average Ability.* In general, low average ability is adequate for those persons dealing with specific processes in which definitions and directions are relatively simple and the making of decisions as to policy or plans is not involved to any significant extent, but requiring good judgment and some discretion in operations, such as: Ticket agent, annealer or temperer of tools, bookbinder, cabinet maker, carpenter, retail cashier, chauffeur, chef, filing clerk,

[1] For additional discussions, see Educational Bulletin No. 14, **The Proper Use of Intelligence Tests**, and No. 15, **Vocational Guidance for Junior and Senior High School Pupils.** Los Angeles: California Test Bureau.

stack clerk, collector, compositor, street car conductor. dressmaker, dry cleaner, electrician, engraver, floor walker in store, landscape gardener, glassblower, tinsmith, harness maker, rivet worker, telephone linesman, machinist, auto mechanic, miller, milliner, motorman, moving picture operator, ornamental iron worker, general painter, metal pattern maker, plasterer, plumber and steam fitter, policeman, repairman, sales clerk, shop mechanic, sign painter, station agent, steeplejack, stock clerk, stonemason, tailor, telephone operator, tool maker, typist, upholsterer, vulcanizer, wheelwright, and woodcarver.

e. *Inferior Ability.* In general, inferior mental ability is adequate for those persons whose duties require that they follow simple and specific directions with little necessity for making significant plans or decisions, such as: Auto assembler, bell boy, blacksmith, boilermaker, brakeman, bricklayer, butcher, cobbler, concrete worker, cook, dairy hand, deliveryman, drayman, farm hand, finisher of metals, fireman, fisherman, foundry worker, hospital attendant, janitor, packer, wrapper, counter, lathe-hand, laundry worker, mail carrier, messenger boy, miller, miner, motorcyclist, motorman, munition worker, oilwell driller, semi-skilled machine operator, paper hanger, patrolman, porter, newsdealer, roofer, saw mill worker, butler, sheet metal worker, shiprigger, smelter worker, soldier, stagehand, stonecutter, structural steel worker, switchman and flagman, textile worker, theatre usher, truck driver, and waiter in restaurant.

f. *Very Inferior Ability.* In general, very inferior mental ability is adequate for persons whose assignments require practically no judgment and who follow simple and specific directions usually under close supervision, such as: Day laborer, railroad section hand, boot-black, chamber maid, scrub woman, ditch digger, elevator operator, farm laborer, garbage collector, guard or watchman, hostler, junk man, street sweeper, and track layer.[1]

The list is intended to be suggestive of the minimum ability requirements which have been found to apply to typical positions. In instances where the duties of a given job are specialized, its classification might be changed. Job specifications, based on an analysis of the specific duties and operations required for given jobs, provide the basic data in determining the mental ability requirements, as well as other requirements for given positions. Civil service departments and employment managers are making such analysis for the purpose of preparing these specifications so that the selective criteria will be fitted to their particular needs.

It should always be remembered that in addition to mental ability, there are other important factors involved in occupational efficiency and adjustment.[2]

2. Employee Placement. Most businesses and industries have a sufficient variety of occupations so that a considerable range of mental ability is required in the various departments, and there are also significant differences within the departments themselves. Employment departments which accumulate data regarding the mental levels required for success in the jobs of the various departments, will be able to establish critical mental ability scores so that they may select candidates who will have the mental capacity necessary for success. When the average I.Q.'s and the "critical" range of abilities which are found among the successful employees have been determined, more satisfactory placements will be obtained. Also, in the problem of up-grading employees, the knowledge of the level of ability of given persons is absolutely essential as a factor in determining their probable success.

Where a personnel department desires to do its work scientifically, it is recommended that all employees be tested and the average I.Q.'s and the variation of I.Q.'s of various departments be determined. These measures should be studied in relation to the service ratings and a range of scores or I.Q. groupings which give the highest probability of success should be established. New employees, or employees to be given the opportunity of promotion, can be selected from the standpoint of capacity so that they will have the optimum qualifications for meeting the intellectual requirements of the position. It is found that individual applicants will often be equally eligible to work in several different departments on the basis of I.Q. In this event, previous experience, interest, health, and personality data may be taken into consideration in making the most appropriate placement.

3. Employee Adjustments. It is frequently necessary to make adjustments and re-assignments of personnel. Since it has cost considerable to select, employ, and place an individual in the given business or industry, it is usually more profitable to try to re-adjust misplaced employees who are not succeeding in their given assignments. This is true, not only because of the cost of employment, placement, and training, but also because other considerations frequently require that they be given the opportunity for further adjustment.

The first step is to determine if the failure is due to lack of capacity; if so, replacement should be made into a simpler type of work. As previously indicated,

[1] For similar additional information see Yoakum and Yerkes: **Army Mental Tests**; Bingham: **Aptitudes and Aptitude Testing**; Viteles: **Industrial Psychology**; Stead, Shartle and Associates: **Occupational Counseling Techniques.**

[2] Attention is called to the fact that certain personality factors, such as capacity for loyalty to the organization, self-reliance, ability to get along with others, and the like, are as essential as ability to do certain types of work. To provide an easily interpreted inventory of information as to personal and social adjustment, the **California Test of Personality** is recommended.

this one factor is frequently of the greatest consequence.

In the relationships between labor and management, it is highly desirable that information be available regarding the mental ability of each of the employees. Those employees of low mental ability tend to be more gullible and suggestible. Also, they have fewer ideas and greater inertia. The higher the mental ability of employees, the greater the danger of dissatisfaction with working conditions, particularly when this higher ability is associated with personality defects, such as may be revealed by the *California Test of Personality* or the *Johnson Temperament Analysis*.[1]

IX. Directions for Giving

The tests in this series are primarily analytical and diagnostic even though they furnish the customary M.A.'s and I.Q.'s. The intention is to secure as accurate an indication as possible of each person's status in the factors tested.

It is desirable that each person shall understand clearly the manner in which he is expected to indicate his responses. However, the examiner must keep in mind that a test rather than a teaching situation is desired and that he should in no way indicate the correct response, except in practice exercises and as instructed. Each person should have a blank sheet of paper. Directions to be given examinees are in blackface type.

When machine scoring answer sheets are to be used, it is necessary to use the special edition of the test and the directions prepared for that purpose.

Time Limits

This is a power rather than a speed test. However, Test 8 requires exact time limits, and the examiner should have available a watch with a second hand. The limits indicated for the other tests are suggested rather than obligatory, but should be followed in most circumstances.

The test should be given in two periods requiring approximately 45 to 50 minutes each. Pages 1-12 should be given during the first period; and after a recess, noon hour, or a day intervenes, the remainder of the test should be administered.

Instructions to Examinees:

Each examinee should fill in the identifying data on the front cover-page of the test booklet. Then the examiner will state: **This booklet contains a number of exercises which I want you to try. After I give you the directions for each test, you will begin when I say "Ready, begin." You are to work as rapidly as you can without making mistakes. When you have completed a test or have done as much of it as you can, wait for further directions.**

Now, open your booklet and fold back the page like this. (Demonstrate and be sure the examinees have the same test.)

Test 1

Furnish each examinee with a sheet of paper to be used to separate the groups of letters if it appears necessary. It is to be used, also, in Test 4.

Look at the top line of Group A. You see the letters D, E, and L and the number 3. The directions are: In each group of letters and numbers, put a circle around the letters and numbers in the second row that are the same as those in the first row of the group. D, L, 3, and E have rings around them to show that they are the same as the letters and the number in the first row. Do all the other groups in the same way. Ready, begin.

Suggested time limit, 3 minutes.

Now turn your booklet over to Test 2.

Test 2

The directions are: In each row, put an X on the line under the object that is named. Then write the number of the object you mark on the line to the right. Look at Row A. Cuff. Put an X on the line under the picture of the cuff and put a 2 on the line to the right. I shall pronounce the word just once. Ready. Row 1. Pronounce words in a normal manner, once only, and allow reasonable time before pronouncing the next word.

Row 1.	Ape	Row 6.	Keg	Row 11.	Nail
Row 2.	Swing	Row 7.	Hoop	Row 12.	Tub
Row 3.	Book	Row 8.	Tire	Row 13.	Rake
Row 4.	Boot	Row 9.	Towel	Row 14.	Cap
Row 5.	Box	Row 10.	Bowl	Row 15.	Bell

Turn the page over to Test 3 and fold it back like this. (Demonstrate.)

Test 3

In this test you are to draw a line between the black lines. The directions are: Start at the first arrow at A and draw a line to each number when called. Try to keep within the black lines. Do not start until I say, "Ready, begin.' Put your pencils on the arrow under the letter A. When I call each number you are to draw a line to that number. Try to keep from touching the lines. Do not lift your pencil from the paper. (Be sure pencils are on arrow at A.)

Ready, begin. 1. Draw a line to number 1. (Allow about 2 seconds between each number, counting very slowly, avoiding suggestion of haste) **2,** etc., to 12. Pause to permit any slow examinees to finish drawing A. **Do B in the same way. Put your pencils on the arrow at B. Ready, begin. 1, etc., to 8.** (Allow about 2 seconds between each

[1] For additional discussion regarding use of tests in business and industry see Ruch, F. L.: **How to Use Employment Tests, Los Angeles: California Test Bureau, 1944. Price 50c.**

number called as in A. Allow examinees to finish drawing B even though they did not keep up with the count.)

Now turn your booklet over to Test 4.

TEST 4

In this test you will use the sheet of paper furnished you. Place it below Row C. Listen to the pairs of words that will be read to you. The first word of each pair will be repeated and you are to remember what went with it. Find the object. Put an X on the line under it and put the number of the object you mark on the line to the right. Ready. Open—door; empty—basket; fly—bird. Look at Row A. What went with open? (Let examinees answer.) Yes, door, so put an X on the line under the second object and put a 2 on the line to the right.

Row B. What went with empty? Yes, basket, so put an X on the line under the first object in the row, a basket, and put a 1 on the line to the right.

Row C. What went with fly? Yes, bird, so put an X on the line under the third object in the row and put a 3 on the line to the right.

Do you understand? The first word of each pair will be repeated and you are to remember what went with it. Find the object, put an X on the line under it and put the number of the object you mark on the line to the right. Pencils up. Do not move your paper down until I tell you. Ready. Listen carefully. Sweet—grapes; (pause) wet—sail; (pause) anchor—anvil; (pause) protecting—battleship; (pause) shadow—airplane. Move your paper down to Row 1. Put an X under what was said with sweet. Move your paper down to Row 2, with wet (pause).

(Examinees are to move paper down one row as the row is called.)

Row 3, with anchor. Row 4, with protecting. Row 5, with shadow. In each row be sure to put the number of the object you mark on the line to the right.

Pencils up. Listen carefully. The next pairs of words are: distant — monument; record — watch; control—parachute; turning—well; 19—R; leaping—kangaroo; idle—chair. Move your paper down so that you can see Row 6. Put an X under what went with distant. Row 7, with record. Row 8, with control. Row 9, with turning. Row 10, with 19. Row 11, with leaping. Row 12, with idle.

Pencils up. Keep your paper at Row 12. Listen carefully. The next pairs of words are: Safety—key; graceful—swan; clear—ice; power—boat; hungry—lion; resting—acorn; base—triangle; circles—spring; danger—sailor. Move your marker down to Row 13. Put an X under what went with safety. Row 14, with graceful. Row 15, with clear. Row 16, with power. Row 17, with hungry. Row 18, with resting. Row 19, with base. Row 20, with circles. Row 21, with danger.

Pencils up. Move your paper up to cover Row 22 and the drawings below it. Listen carefully. The next pairs are: driving—wheel; desert—camel; steady — ship; land — compass; settlement — gun; amount—kettle; boundary—leaf; weight—iceberg; knowing—signal; sharp—porcupine; time—moon; life—sun. Row 22, put an X under what went with driving. Row 23, with desert. Row 24, with steady. Row 25, with land. Row 26, with settlement. Row 27, with amount. Row 28, with boundary. Row 29, with weight. Row 30, with knowing. Row 31, with sharp. Row 32, with time. Row 33, with life.

Now turn the page over to Test 6 and fold it back.

TEST 6

Look at all these pictures of hands and feet and other objects. Under each picture is a letter R, meaning right, and a letter L, meaning left. The directions are: Put a circle around the letter R in all rights. Put a circle around the letter L in all lefts. The first two are correctly marked. Ready, begin.

Allow 3 minutes.

Now turn your booklet over to Test 7.

TEST 7

Look at the first drawing in Row A. Now look at all the other drawings in Row A. (Examiner points to the drawings in Row A.) The first drawing is among the other drawings in this row. Which one is it? (Let the group respond.) Yes. It is number 2. So put an X on the line under the second drawing and put a 2 on the line to the right. The directions are: In each row, find a drawing that is either the same or different views of the first drawing. Put an X on the line under this drawing and put the number of the drawing you mark on the line to the right. Do not give too much time to any one item. You will have just eight minutes. Ready, begin.

Allow 8 minutes.

Now turn the page over to Test 8 and fold it back.

TEST 8

Look at all these drawings. Notice they are all joined so that you can go from drawing A to drawing 10 without going outside any of the drawings. Pencils up. The directions are: Begin at the arrow in drawing A. Draw a line to show the path you would take through all the drawings so as to finish drawing 10. Go as quickly as you can. Ready, begin.

Allow exactly 2 minutes.

Now turn your booklet over to Test 9.

TEST 9

Look at the first object in Row A. (Examiner points to Row A.) A piece of cake. It is sweet. Now look at all the other objects in the same row. One is the opposite of the first object. (Let the class respond.) Yes, the second picture is a lemon. It is sour. Put an X on the line under it and put a 2 on the line to the right. Do it now. (Pause.) The direction are: In each row there is one object that represents the opposite of the first object. Put an X on the line under it, and put the number of the object you mark on the line to the right. Do not give too much time to any one item. You will have just five minutes. Ready, begin.

Allow 5 minutes.

Now turn the page over and fold it back.

TEST 10

Look at the pictures in Row A. (Examiner points to the pictures in Row A.) The first three objects are alike in some way. What way? (Let the group respond.) Yes, they are all cleaning brushes. Now look along Row A to the right and find something else like them. Which is it? (Let the group respond.) Yes, the tooth brush is right. It belongs with the first three in this row. So put an X on the line under it and put a 3 on the line to the right. Do it now. (Pause.) The directions are: The first three objects in each row are alike in some way. Find another object in the same row that belongs with them. Put an X on the line under it, and put the number of the object you mark on the line to the right. Do not give too much time to any one item. You will have just five minutes. Ready, begin.

Allow 5 minutes.

Now turn your booklet over to Test 11.

TEST 11

Look at the objects in Row A. A speedometer, an automobile, a thermometer, a rose, the sun, a turnip, and an airplane. The first object is related to the second in some way. What way? (Get responses from the group.) Yes, the sun. The speedometer measures how fast the automobile is traveling. Now look at the third object, a thermometer. Look at the other objects in this row and find one to which the thermometer is related in the same way that the speedometer is related to the automobile. (Get responses from the group.) Yes, the sun. Put an X on the line under it and put a 2 on the line to the right. Do it now. The speedometer measures speed and the thermometer measures how hot or cold it is —that is, temperature. (Pause.) The directions are: In each row the first object is related to the second. Find an object that goes with the third object in the same way. Put an X under it and put the number of the object you mark on the line to the right. You will have just five minutes. Ready, begin.

Allow 5 minutes.

Now turn the page over and fold it back.

TEST 12

Look at the first row of numbers in the samples on this page: 2, 4, 6, 8, 9, 10. You see that the numbers count up by twos, but there is one wrong number. Which is it? (Pause.) Yes, 9. The numbers should be 2, 4, 6, 8, 10, so a line is drawn under the 9, and 9 is put on the line to the right. Now look at the second row of numbers: 11, 9, 8, 7, 5, 3, 1. Which number is wrong here? (Pause.) Yes, 8. These numbers count down by two's and should be 11, 9, 7, 5, 3, 1. Thus the 8 is underlined and 8 is put on the line to the right. The directions are: In each row of numbers below, there is one that is wrong. Find this wrong number and draw a line under it. Then write it on the line to the right.

Also do K, L, M, N, and O. You will have just 5 minutes to do all the problems on this page.

Ready, begin.

Allow 5 minutes.

TEST 13

Look at the five columns headed: cent; nickel; dime; quarter; half-dollar. (Examiner points to these columns in the test held up before the group.) These are some problems for you to work. (Examiner points to the problems at the left of the page.) Look at the first problem. It asks what two coins make 10 cents. Since we can use only two coins, our choice must be two nickels, and we put a 2 on the line under the five cents or nickel column. The next problem asks what 7 coins make 25 cents. The only 7 coins that make 25 cents are 5 one cent pieces and 2 dimes, so we place a 5 in the cent column, and a 2 in the dime column. The directions are: In each problem you are to find a certain number of coins to make a certain amount of money. Put the number of coins required under the name of the coin.

Allow 5 minutes.

There should be a recess at this time.

TEST 5

(This test consists of a story which is read just before Test 14 is given so that about 30 minutes will have elapsed before responses are made on page 16.)

Put your pencils down. Sit back in your seats. I am going to read you a short report. You must listen carefully so that you will remember everything it says. The name of the report I am going to read is "The Place of the Dream Among the Huron Indians." (Examiner reads the following account in a clear steady tone of voice usual for reading or making reports. Repeat the title.)

THE PLACE OF THE DREAM AMONG THE HURON INDIANS

Researches into the customs of the Huron Indians living in Northeastern North America in the seventeenth and eighteenth centuries show that these Indians attached great importance to their dreams. These dreamers in the wildernesses believed that their dreams were the direct reflection of the wish of their Manitou, a great spirit who controlled their destiny. Every wish of the Manitou had to be satisfied by giving a feast or a festival of some sort in his honor.

In the recorded dreams of these Indians food of various kinds was mentioned very frequently, always in easy and ready connection with feasts, in the preparing and eating of which the entire village entered with hearty accord. The dream demanded full and detailed satisfaction. However, if an article originally required by the dream were not obtainable, some other article must be found to substitute for it. Gull's eggs not in season might be replaced at the feast by small loaves of bread, the baking of which kept the women of the village busy for hours. If the season were unfavorable for elk hunting, elk meat might be replaced by fish, beaver, or even by large loaves of bread obtainable from the French.

Articles of clothing, furnishings, ornaments, and property of all kinds entered abundantly into the dreams of the Hurons. An Indian, especially one who was sick, had but to dream that he wished to refurnish his cabin and announce his dream. Promptly the men of the village collected in loose organization and invaded unresisted all the cabins, carrying away any object they fancied to the cabin of the lucky dreamer.

Other dreams were concerned with defense. The report of a dream in which an enemy was taken captive was followed by general feasting and bestowing of public honors on the dreamer. In contrast, he who dreamed of being captured by the enemy received publicly all the tortures that would have been meted out to an actual captive, as a stimulus to courage.

Revenge was often the motive for a dream. An Indian dreamed that he saw ten men plunge into the frozen river, entering by one hole in the ice and coming out by another. On awaking, he invited ten of his friends to such a diving contest in the river which was then frozen over. Among the ten was one against whom he held a grudge. This swimmer was lacking in skill and perished under the ice.

Other dreams were clearly concerned with ordinary social affairs. These dreams gave rise to occasions for getting together for social enjoyment and for competition among themselves and with a neighboring tribe. Conspicuous among their games was the "Game of Dish," entered into in response to a dream. Participation of a neighboring tribe called for a formal message by an envoy inviting the neighboring tribe to a game of dish. The place of meeting was determined by drawing lots. The festival lasted for days. In the game, the contesting tribes sat on the ground facing each other, each with a bowl containing seeds of the white plum. These seeds were black on one side and white on the other. The game consisted in tossing the seeds in the bowl until the color agreed upon was on top in all the seeds. The contest over, the invited tribe left for home thus bringing to an end a sort of field-meet in which young and old entered heartily.

The Indian dreamed of things he desired and things he feared. Through the institution of the feast or festival in response to the dream, he was given a certain advantage. The carrying out of this custom tended to lessen the dulling effect of an otherwise unrelieved monotony in primitive life during times of peace, as well as to justify the revengeful and satisfy the covetous.

Now turn your booklet over to Test 14.

TEST 14

The directions are: Work these problems on a blank sheet of paper. Write the letter of the answer on the line to the right. The correct answer for the first problem (A) is b. You will have ten minutes. Ready, begin.

Allow 10 minutes.

Now turn the page over to Test 15 and fold it back.

TEST 15

Read aloud the directions at the top of the page and the complete sample. **The correct answer is the third one: All horses are animals. A line is drawn under it and a 3 is put on the line to the right. Do all the others on the page. You will have ten minutes. Ready, begin.**

Allow 10 minutes.

Now turn your booklet over to Test 16.

TEST 16

Read aloud the directions and the sample. **The third word, flower, has a line drawn under it because it is the same as blossom. A 3 is written on the line to the right. Do the others on the page in the same way. You will have ten minutes. Ready, begin.**

Allow 10 minutes.

Now turn to the last page.

TEST 5 (Page 16)

On this page are some questions about the story read to you a little while ago. The directions are:

1946 Revision

Advanced
Grades 9-Adult

CALIFORNIA TEST OF MENTAL MATURITY—ADVANCED SERIES

Devised by Elizabeth T. Sullivan, Willis W. Clark, and Ernest W. Tiegs

Name Harold Brown Occupation or Grade L10 (10.4)

Date Jan. 15 Age 15 Last Birthday Nov 10 (182 Mo.) Sex: (M) F

Teacher or Examiner Miss Ross School or Organization Lincoln High

TEST FACTOR	Possible Score	Score	Low	Average	High
1. Visual Acuity	40	38	0–28	29–40	⊗
2. Auditory Acuity	15	14	0–9	10–15	⊗
3. Motor Co-ordination	20	12	0–10	11–18	19–20

DIAGNOSTIC PROFILE
(Chart scores here)

TEST FACTOR	Possible Score	Score	Yr.	Percentile Rank
A. Memory	53	38		30
4. Immediate Recall*	33	22		
5. Delayed Recall (p. 16)	20	16		
B. Spatial Relationships	45	22		30
6. Sensing Right and Left*	20	14		
7. Manipulation of Areas*	15	3		
8. Foresight in Spatial Sit'n*	10	5		
C. Logical Reasoning	60	30		60
9. Opposites*	15	8		
10. Similarities*	15	8		
11. Analogies*	15	5		
15. Inference (p. 14)	15	9		
D. Numerical Reasoning	45	21		50
12. Number Series*	15	7		
13. Numerical Quantity*	15	9		
14. Numerical Quantity	15	5		
E. 16. Vocabulary	50	47		80
Total Mental Factors (A+B+C+D+E)	253	128		60
F. Language Factors (5+14+15+16)	100	47		70
G. Non-Language Factors (Total Mental Factors Minus F)	153	81		50
Chronological Age		182		
Actual Grade Placement (Grade pupil is in)		10.4		

Mental Age Mo. 120 132 144 156 168 180 192 204 216 228 240 300 360

Yr. 10 11 12 13 14 15 16 17 18 19 20 25 30

*Non-Language tests.

SUMMARY OF DATA

	Score	M. A.	÷	C. A.*	=	I. Q.
Total Mental Factors	128	193		182		106
F. Language Factors	47	202		182		111
G. Non-Language Factors	81	184		182		101

*Age 16 and older, divide by 192 months.

Published by California Test Bureau
5916 Hollywood Boulevard, Los Angeles 28, California

Read the following and draw a line under the correct answer. Put the number of this answer on the line to the right. (Read the sample aloud.) The answer is "The Hurons," so a line is drawn under it and number 3 is put on the line to the right. Do the others on the page in the same way. Ready, begin.

Allow examinees to finish as much as they can, but 10 minutes should be sufficient. Then say: STOP.

Turn your booklet over,—front cover-page up.

X. Directions for Scoring

The examiner should use the key which is furnished with the tests as an aid in scoring. It is advisable that the examiner take the test, or carefully examine the responses made by an examinee, in order to become acquainted with the test situations.

General Instructions:

1. In scoring the tests, each item is considered right or wrong. No partial credits are given.

2. Mark each correct item with a "C." If two or more answers are given count as wrong, unless the person has attempted to erase, cross out, or otherwise indicate his intention.

3. Examinees are not penalized if they fail to record the number of the test item, as this is simply an aid in scoring. Consider the person's intention if that can be determined. If doubtful, count as "wrong."

4. The score for each test is the number right.

5. Record the number right at the bottom of each test.

6. Transfer the scores to the front page of the test booklet. Note particularly the location of Test 5 and Test 15 scores.

XI. Instructions for Front Cover Page of the Booklet

Purpose

The front cover page of the test booklet is designed to furnish a record of test results which may be torn from the test booklet and kept as a permanent record. It provides for a Summary of the essential information and for a Diagnostic Profile as an aid in interpreting test data.

Method

1. Record the Examinee's Score for each of Tests 1 to 15 on the light-face rule immediately to the right of the Possible Score in each case. Note that Test 15 is located after Test 11 on the profile. The score for Test 16 is entered directly on the heavy-face rule.

2. Add Scores on Tests 4 and 5 and write this sum on the heavy-face rule to the right of Possible Score 53; this is the Total Score for Memory. Add the Scores for Tests 6, 7, and 8, and write this sum on the heavy-face rule to the right of Possible Score 45; this is the Total Score for Spatial Relationships. Add the Scores on Tests 9, 10, 11, and 15. Write this sum on the heavy-face rule to the right of Possible Score 60; this is the Total Score for Logical Reasoning. Add the Scores on Tests 12, 13, and 14. Write this sum on the heavy-face rule to the right of Possible Score 45; this is the Score for Numerical Reasoning.

3. Add these totals for Memory (A), Spatial Relationships (B), Logical Reasoning (C), Numerical Reasoning (D), and Vocabulary (E), to obtain Total Mental Factors score. Record this sum on the heavy rule to the right of Possible Score 253.

4. The tests requiring a significant use of the verbal or language factor are 5, 15, 14, and 16. These four scores are added to obtain the Language Factors score which is designated as F and recorded on the heavy rule to the right of Possible Score 100.

5. The tests which are primarily non-verbal are indicated by a star (*) and are 4, 6, 7, 8, 9, 10, 11, 12, and 13. The Non-Language Factors score (G) is most easily obtained by subtracting the Language Factors score (F) from the Total Mental Factors score. Record this difference on the heavy rule to the right of Possible Score 153.

6. Chronological Age is the actual life age of the individual in months. It is essential that this age be correct for purpose of calculating the I.Q.'s of persons under 16 years of age. (In all cases where the individual is 16 years of age or older, 192 months is used as the divisor in obtaining I.Q.'s. However, each examinee's correct age is recorded on the line to the right of Chronological Age.) The age should be determined from a teacher's register, examinee's birth certificate, or other sources, if these are doubtful.

*7. Actual Grade Placment is the grade in which a student is actually working at the time he takes the test, expressed as a fraction of the school year. It is determined by adding the decimal fraction of the school year to the grade assignment, as follows:

	(Low)	(High)
September or February	.0	.5
October or March	.1	.6
November or April	.2	.7
December or May	.3	.8
January or June	.4	.9

In the illustration on the opposite page, the student was a Low 10 (L10) in January, or 10.4.

8. The Summary of Data is secured by transferring the Total, and F and G scores, to the space provided at the bottom of the page under Score. The Mental Ages are then found by using the norms on the last page of this Manual of Directions in the following manner: To find Mental Age for Total

* Ignore this paragraph when testing adults.

Mental Factors, locate the third from the left column and follow it until you reach the Total Mental Factors score which was obtained by the examinee; the corresponding Mental Age in months is found directly to the left in the first column. Mental Ages in Language and Non-Language factors are found similarly by locating the Scores in F and G (4th and 5th columns from the left) and reading the corresponding Mental Ages in months in the first column. Chronological Age (C.A.) in months is written to the right of each Mental Age in months except that for all individuals 16 years of age and older, 192 mo. is used as the divisor. The divisions are performed as indicated in order to obtain the three I.Q.'s.

Note: These divisions are already prepared on "Age and I.Q. Calculator." Published by California Test Bureau, $1.00.

9. The Diagnostic Profile presents graphically evidence of the maturity of development of each person in many specific types of mental activity. It is easily completed by locating Scores and other data on the light and heavy rule scales to the right of the Scores, as illustrated on page 14. For example, the examinee in this case obtained a score of 22 in Spatial Relationships. This score is next located on the heavy rule to the right. The Mental Age (in months or years and months) to which this score corresponds may then be read directly above or below on the heavy rules. In the illustration the Mental Age is about 162 months. The Mental Age equivalents of each major division and each sub-test may be obtained in the same manner.

10. The Percentile Ranks at the extreme right of the profile are obtained by use of the tables for each age group appearing on pages 17 and 18, entitled "Percentile Norms for Scores of Various Mental Factors." Care must be taken to use the correct age table.

Interpretation of the Profile

The authors of the *California Test of Mental Maturity* believe that these test data and the methods of their presentation on the cover-page provide several significant features. The profile furnishes the following advantages:

1. It visualizes the significant elements of the individual's responses.

2. It analyzes and summarizes the various factors which are measured by the test situations.

3. As a professional device, it reduces the "mystery" which has surrounded the meaning of Mental Age and Intelligence Quotient. The examiner may readily note strengths and weaknesses of responses in the various situations which together provide a measure of mental capacity.

In the interpretation of responses for individuals on the various tests, the examiner is referred to the detailed descriptions of the tests which appear as Sections VI and VII on pages 3-6 of this Manual.

C. T. M. M. Advanced Series Norms

(Continued from Page 20)

MENTAL AGE Month	MENTAL AGE Yr.-Mo.	Total Mental Factors	(F) Language Factors	(G) Non-Language Factors	Grade Placement	I.Q. for age 16 and older
95	7-11	11	2	— 8	—2.6	—50
96	8- 0	12-13	....	9-10	2.6	50
97	8- 1	14	3	11	2.7	50
98	8- 2	15-16	....	12	2.8	51
99	8- 3	17	....	13	2.8	52
100	8- 4	18-19	4	14	2.9	52
101	8- 5	20	....	15	3.0	53
102	8- 6	21	5	16	3.1	53
103	8- 7	22	....	17	3.2	54
104	8- 8	23-24	....	18	3.2	54
105	8- 9	25	6	19	3.3	55
106	8-10	26	....	20	3.4	55
107	8-11	27	....	....	3.5	56
108	9- 0	28	7	21	3.6	56
109	9- 1	29-30	....	22	3.7	57
110	9- 2	31	....	23	3.8	57
111	9- 3	32	8	24	3.8	58
112	9- 4	33	....	25	3.9	58
113	9- 5	34-35	....	26	4.0	59
114	9- 6	36	9	27	4.1	59
115	9- 7	37-38	....	28	4.2	60
116	9- 8	39	....	29	4.2	60
117	9- 9	40-41	10	30	4.3	61
118	9-10	42	....	31	4.4	61
119	9-11	43	....	32	4.5	62
120	10- 0	44	11	33	4.6	62
121	10- 1	45-46	....	34	4.6	63
122	10- 2	47	....	35	4.7	63
123	10- 3	48	12	36	4.8	64
124	10- 4	49	....	37	4.8	65
125	10- 5	50-51	13	38	4.9	65

(Continued on Page 20)

MENTAL AGE Month	MENTAL AGE Yr.-Mo.	Total Mental Factors	(F) Language Factors	(G) Non-Language Factors	Grade Placement	I.Q. for age 16 and older
282	23- 6	196	....	....	....	147
283	23- 7	.....	77	....	....	147
284	23- 8	197	....	120	....	148
285	23- 9	.....	....	....	....	148
286	23-10	198	78	....	....	149
287	23-11	199	....	121	....	149
288	24- 0	200	79	....	....	150
289	24- 1	.....	....	122	....	150
290	24- 2	201	....	....	....	151
291	24- 3	.....	80	....	....	152
292	24- 4	202	....	123	....	152
293	24- 5	.....	81	....	....	153
294	24- 6	203	....	....	....	153
295	24- 7	.....	....	124	....	154
296	24- 8	204	82	....	....	154
297	24- 9	205	....	....	....	155
298	24-10	206	....	....	....	155
299	24-11	.....	....	....	....	156
300	25- 0	207-209	83-84	125-126	....	156
306	25- 6	210-213	85	127-128	....	159
312	26- 0	214-216	86-87	129-130	....	162
318	26- 6	217-219	88	131	....	166
324	27- 0	220-223	89-90	132-133	....	169
330	27- 6	224-226	91	134-135	....	172
336	28- 0	227-229	92-93	136-137	....	175
342	28- 6	230-233	94	138-139	....	178
348	29- 0	234-236	95-96	140	....	181
354	29- 6	237-239	97	141-142	....	184
360	30- 0	240-246	98	143-148	....	187
372	31- 0	247-252	99	149-152	....	194
384	32- 0	253	100	153	....	200

PERCENTILE NORMS FOR SCORES OF VARIOUS MENTAL FACTORS

FOR USE WITH

CALIFORNIA TEST OF MENTAL MATURITY—Advanced Series

TABLE FOR AGE 12-0 to 12-11

MENTAL FACTORS	Percentile Norms												
	1	5	10	20	30	40	50	60	70	80	90	95	99
A. Memory (Tests 4 and 5)	0- 9	10-15	16-20	21-25	26-29	30-32	33-35	36-37	38-39	40-41	42-43	44-45	46+
B. Spatial Relationships (Tests 6, 7, and 8)	0- 6	7- 8	9-11	12-14	15-16	17-18	19-20	21	22-23	24	25-26	27-28	29+
C. Logical Reasoning (Tests 9, 10, 11, and 15)	0- 8	9-11	12-13	14-15	16	17	18	19-20	21-22	23-24	25-27	28-31	32+
D. Numerical Reasoning (Tests 12, 13, and 14)	0- 5	6- 8	9-10	11	12	13	14	15-16	17-18	19-20	21-22	23-26	27+
E. Vocabulary (Test 16)	0	1	2	3	4	5	6	7- 8	9	10-11	12-13	14-16	17+
TOTAL MENTAL FACTORS	0-30	31-37	38-47	48-59	60-69	70-79	80-87	88-95	96-103	104-112	113-121	122-138	139+
F. Language Factors (Tests 5, 14, 15, and 16)	0- 5	6- 7	8-10	11-14	15-18	19-22	23-26	27-29	30-33	34-37	38-41	42-49	50+
G. Non-Language Factors (Tests 4, 6, 7, 8, 9, 10, 11, 12, 13)	0-26	27-30	31-35	36-43	44-50	51-56	57-62	63-67	68-72	73-77	78-83	84-94	95+
	1	5	10	20	30	40	50	60	70	80	90	95	99
	Percentile Norms												

TABLE FOR AGE 13-0 to 13-11

MENTAL FACTORS	Percentile Norms												
	1	5	10	20	30	40	50	60	70	80	90	95	99
A. Memory (Tests 4 and 5)	0-11	12-17	18-23	24-27	28-31	32-35	36-37	38-39	40-41	42-43	44-45	46-47	48+
B. Spatial Relationships (Tests 6, 7, and 8)	0- 7	8- 9	10-12	13-16	17-19	20-21	22	23	24-25	26	27	28-29	30+
C. Logical Reasoning (Tests 9, 10, 11, and 15)	0- 9	10-12	13-14	15-16	17	18-19	20-21	22-23	24-25	26-28	29-31	32-36	37+
D. Numerical Reasoning (Tests 12, 13, and 14)	0- 7	8- 9	10-11	12	13	14-15	16-17	18-19	20-21	22-23	24-26	27-31	32+
E. Vocabulary (Test 16)	0- 1	2	3	4	5	6	7- 8	9	10-11	12-13	14-15	16-19	20+
TOTAL MENTAL FACTORS	0-35	36-48	49-63	64-74	75-84	85-92	93-100	101-108	109-117	118-126	127-135	136-150	151+
F. Language Factors (Tests 5, 14, 15, and 16)	0- 7	8-12	13-16	17-20	21-24	25-28	29-32	33-35	36-39	40-43	44-48	49-57	58+
G. Non-Language Factors (Tests 4, 6, 7, 8, 9, 10, 11, 12, 13)	0-29	30-34	35-43	44-53	54-60	61-65	66-70	71-75	76-79	80-84	85-90	91-98	99+
	1	5	10	20	30	40	50	60	70	80	90	95	99
	Percentile Norms												

TABLE FOR AGE 14-0 to 14-11

MENTAL FACTORS	Percentile Norms												
	1	5	10	20	30	40	50	60	70	80	90	95	99
A. Memory (Tests 4 and 5)	0-15	16-21	22-26	27-31	32-35	36-39	40-41	42	43-44	45	46	47-48	49+
B. Spatial Relationships (Tests 6, 7, and 8)	0-10	11-13	14-17	18-19	20-21	22-23	24	25	26-27	28	29	30-31	32+
C. Logical Reasoning (Tests 9, 10, 11, and 15)	0-11	12-14	15-16	17-18	19-20	21-22	23-24	25-26	27-29	30-32	33-35	36-38	39+
D. Numerical Reasoning (Tests 12, 13, and 14)	0- 8	9-10	11-12	13-14	15-16	17-18	19-20	21-22	23-24	25-27	28-30	31-33	34+
E. Vocabulary (Test 16)	0- 1	2	3- 4	5- 6	7- 8	9-10	11	12	13-14	15-16	17-18	19-24	25+
TOTAL MENTAL FACTORS	0-40	41-61	62-74	75-86	87-95	96-104	105-113	114-121	122-130	131-138	139-149	150-161	162+
F. Language Factors (Tests 5, 14, 15, and 16)	0- 9	10-14	15-19	20-24	25-29	30-32	33-36	37-40	41-44	45-49	50-54	55-63	64+
G. Non-Language Factors (Tests 4, 6, 7, 8, 9, 10, 11, 12, 13)	0-31	32-43	44-53	54-62	63-68	69-73	74-77	78-81	82-86	87-91	92-97	98-104	105+
	1	5	10	20	30	40	50	60	70	80	90	95	99
	Percentile Norms												

PERCENTILE NORMS FOR SCORES OF VARIOUS MENTAL FACTORS

FOR USE WITH

CALIFORNIA TEST OF MENTAL MATURITY—Advanced Series

TABLE FOR AGE 15-0 to 15-11

MENTAL FACTORS	Percentile Norms												
	1	5	10	20	30	40	50	60	70	80	90	95	99
A. Memory (Tests 4 and 5)	0-17	18-23	24-29	30-33	34-38	39-41	42-43	44	45	46	47	48-49	50+
B. Spatial Relationships (Tests 6, 7, and 8)	0-11	12-14	15-18	19-21	22-23	24-25	26	27	28	29	30-31	32-34	35+
C. Logical Reasoning (Tests 9, 10, 11, and 15)	0-12	13-15	16-17	18-19	20-22	23-25	26-28	29-30	31-32	33-35	36-38	39-41	42+
D. Numerical Reasoning (Tests 12, 13, and 14)	0- 9	10-12	13-14	15-16	17-18	19-20	21-22	23-24	25-27	28-30	31-32	33-34	35+
E. Vocabulary (Test 16)	0- 1	2- 4	5- 6	7- 8	9-10	11	12	13-14	15-16	17-18	19-22	23-28	29+
TOTAL MENTAL FACTORS	0-44	45-72	73-88	89-99	100-108	109-116	117-124	125-132	133-140	141-149	150-158	159-170	171+
F. Language Factors (Tests 5, 14, 15, and 16)	0-11	12-19	20-26	27-30	31-34	35-38	39-42	43-46	47-50	51-54	55-59	60-68	69+
G. Non-Language Factors (Tests 4, 6, 7, 8, 9, 10, 11, 12, 13)	0-34	35-50	51-62	63-69	70-74	75-79	80-84	85-89	90-94	95-98	99-102	103-109	110+
	1	5	10	20	30	40	50	60	70	80	90	95	99
	Percentile Norms												

TABLE FOR AGE 16 YEARS (192 MONTHS) AND OLDER (Inc. Adults)

MENTAL FACTORS	Percentile Norms												
	1	5	10	20	30	40	50	60	70	80	90	95	99
A. Memory (Tests 4 and 5)	0-18	19-25	26-31	32-35	36-39	40-42	43-44	45	46	47	48	49- 50	51+
B. Spatial Relationships (Tests 6, 7, and 8)	0-12	13-16	17-19	20-21	22-23	24-25	26-27	28	29	30	31- 32	33- 35	36+
C. Logical Reasoning (Tests 9, 10, 11, and 15)	0-13	14-16	17-19	20-21	22-23	24-26	27-29	30-32	33-35	36-38	39- 40	41- 42	43+
D. Numerical Reasoning (Tests 12, 13, and 14)	0-10	11-13	14-15	16-17	18-19	20-21	22-23	24-25	26-28	29-31	32- 34	35- 37	38+
E. Vocabulary (Test 16)	0- 1	2- 5	6- 7	8- 9	10-11	12	13	14-15	16-17	18-19	20- 23	24- 30	31+
TOTAL MENTAL FACTORS	0-48	49-77	78-91	92-103	104-112	113-122	123-131	132-139	140-148	149-155	156-165	166-182	183+
F. Language Factors (Tests 5, 14, 15, and 16)	0-12	13-21	22-27	28-31	32-35	36-39	40-44	45-48	49-52	53-56	57- 61	62- 69	70+
G. Non-Language Factors (Tests 4, 6, 7, 8, 9, 10, 11, 12, 13)	0-36	37-55	56-64	65-71	72-77	78-82	83-87	88-91	92-96	97-99	100-104	105-112	113+
	1	5	10	20	30	40	50	60	70	80	90	95	99
	Percentile Norms												

PERCENTILE AND DECILE NORMS

for use with

CALIFORNIA TEST OF MENTAL MATURITY
NEW CALIFORNIA SHORT-FORM TEST OF MENTAL MATURITY
CALIFORNIA CAPACITY QUESTIONNAIRE

PERCENTILE RANK OF I. Q.'s FOR VARIOUS POPULATIONS

(For use with Languoge, Non-Longuoge, ond Total Score Data)

Percentiles	1	5	10	20	25	30	40	50	60	70	75	80	90	95	99	Median	S. D.
Normal Population I.Q.'s incl. gr. 7-8 (N=100,000)	64-	65-76	77-82	83-86	87-88	89-92	93-97	98-102	103-107	108-111	112-113	114-117	118-123	124-135	136+	100.0	16.0
Ninth Grade I.Q.'s (N=25,000)	65-	66-77	78-86	87-89	90-91	92-93	94-98	99-103	104-108	109-112	113-114	115-118	119-123	124-135	136+	101.5	15.5
Tenth Grade I.Q.'s (N=25,000)	67-	68-78	79-87	88-90	91-92	93-94	95-99	100-104	105-109	110-113	114-115	116-119	120-124	125-136	137+	103.0	15.5
Eleventh Grade I.Q.'s (N=25,000)	69-	70-79	80-88	89-91	92-93	94-95	96-100	101-105	106-110	111-114	115-116	117-120	121-126	127-137	138+	104.0	15.5
Twelfth Grade I.Q.'s (N=25,000)	72-	73-80	81-89	90-92	93-94	95-97	98-101	102-106	107-112	113-116	117-118	119-122	123-128	129-139	140+	105.0	15.0
College Freshman I.Q.'s (N=15,000)	87-	88-93	94-98	99-100	101-102	103-104	105-108	109-112	113-117	118-121	122-123	124-127	128-134	135-147	148+	110.0	14.0
Coll. Graduate I.Q.'s (N=2,000)	99-	100-107	108-112	113-115	116-117	118-120	121-123	124-126	127-129	130-132	133-134	135-137	138-145	146-155	156+	125.0	12.0

NOTE: If the user desires to eliminate the 25 and 75 percentiles in his distributions, assign the lower I. Q. of each to the 20 or 70 percentile interval, and assign the higher I. Q. of each to the 30 or 80 percentile interval. For example, in the Norman Population I. Q. group, the I. Q.'s of the 20%ile would become 83-87, and those of the 30%ile would become 88-92.

I. Q. DECILES for the CALIFORNIA TEST OF MENTAL MATURITY

Deciles:	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	Median
Normal Population I. Q.'s:	79-	80- 85	86- 90	91- 95	96- 99	100-104	105-109	110-114	115-120	121+	100.0
Ninth Grade I. Q.'s:	82-	83- 88	89- 92	93- 97	98-101	102-106	107-111	112-116	117-122	123+	101.5
Tenth Grade I. Q.'s:	83-	84- 89	90- 93	94- 98	99-102	103-107	108-112	113-117	118-123	124+	103.0
Eleventh Grade I. Q.'s:	84-	85- 89	90- 94	95- 99	100-103	104-108	109-113	114-118	119-124	125+	104.0
Twelfth Grade I. Q.'s:	85-	86- 90	91- 95	96- 99	100-104	105-109	110-114	115-119	120-125	126+	105.0
College Freshmen I. Q.'s:	95-	96-100	101-103	104-106	107-110	111-115	116-120	121-125	126-131	132+	110.0

NOTE: Decile ratings for the "normal population" group are recommended for use in all cases, except where a rating is to be made for comparison with pupils of a given educational level.

C. T. M. M. ADVANCED SERIES NORMS

(These revisions affect only Language and Non-Language Norms for the Mental Ages 17.0 and above)

(For scores lower than these, see page 16)

MENTAL AGE Month	MENTAL AGE Yr.-Mo.	Total Mental Factors	(F) Language Factors	(G) Non-Language Factors	Grade Placement	I.Q. for age 16 and older
126	10- 6	52	....	39	5.0	66
127	10- 7	53	....	40	5.1	66
128	10- 8	54	14	41	5.2	67
129	10- 9	55-56	....	42	5.2	67
130	10-10	57	15	43	5.3	68
131	10-11	58-59	....	44	5.4	68
132	11- 0	60	16	....	5.5	69
133	11- 1	61	....	45	5.6	69
134	11- 2	62	....	46	5.6	70
135	11- 3	63	17	47	5.7	70
136	11- 4	64	....	48	5.8	71
137	11- 5	65-66	....	....	5.8	71
138	11- 6	67	18	49	5.9	72
139	11- 7	68	....	50	6.0	72
140	11- 8	69	19	51	6.1	73
141	11- 9	70-71	....	52	6.1	73
142	11-10	72	....	....	6.2	74
143	11-11	73	20	53	6.3	74
144	12- 0	74	....	54	6.4	75
145	12- 1	75-76	21	55	6.5	75
146	12- 2	77	....	....	6.6	76
147	12- 3	78	22	56	6.6	77
148	12- 4	79	....	57	6.7	77
149	12- 5	80-81	23	58	6.8	78
150	12- 6	82	....	59	6.9	78
151	12- 7	83	....	....	6.9	79
152	12- 8	84	24	60	7.0	79
153	12- 9	85	....	61	7.1	80
154	12-10	86	25	....	7.2	80
155	12-11	87	....	62	7.3	81
156	13- 0	88	26	63	7.4	81
157	13- 1	89-90	....	....	7.5	82
158	13- 2	91	27	64	7.6	82
159	13- 3	92	....	65	7.7	83
160	13- 4	93	....	....	7.8	83
161	13- 5	94	28	66	7.9	84
162	13- 6	95	....	67	8.0	84
163	13- 7	96-97	29	....	8.1	85
164	13- 8	98	....	68	8.2	85
165	13- 9	99	30	69	8.3	86
166	13-10	100	....	....	8.4	86
167	13-11	101-102	31	70	8.5	87
168	14- 0	103	....	71	8.6	87
169	14- 1	104	32	72	8.7	88
170	14- 2	105	....	....	8.8	88
171	14- 3	106	....	73	8.8	89
172	14- 4	107	33	74	8.9	90
173	14- 5	108	....	....	9.0	90
174	14- 6	109	34	75	9.1	91
175	14- 7	110	....	76	9.2	91
176	14- 8	111	35	....	9.3	92
177	14- 9	112	....	77	9.4	92
178	14-10	113	36	....	9.5	93
179	14-11	114	....	78	9.6	93
180	15- 0	115	....	....	9.7	94
181	15- 1	116	37	79	9.8	94
182	15- 2	117	....	....	9.9	95
183	15- 3	118	....	80	10.0	95
184	15- 4	119	38	81	10.1	96
185	15- 5	120	....	....	10.1	96
186	15- 6	121	39	82	10.2	97
187	15- 7	122	....	....	10.3	97
188	15- 8	123	40	83	10.4	98
189	15- 9	124	....	....	10.5	98
190	15-10	125	41	84	10.6	99
191	15-11	126	....	....	10.7	99
192	16- 0	127	42	85	10.8	100
193	16- 1	128	....	....	10.9	101
194	16- 2	129	43	86	10.9	101
195	16- 3	130	....	....	11.0	102
196	16- 4	131	44	87	11.1	102
197	16- 5	.....	....	....	11.2	103
198	16- 6	132	45	88	11.3	103
199	16- 7	133	....	....	11.4	104
200	16- 8	134	46	89	11.5	104
201	16- 9	135	....	....	11.6	105
202	16-10	136	47	90	11.7	105
203	16-11	137	....	....	11.8	106
204	17- 0	138	....	91	11.8	106
205	17- 1	.....	48	....	11.9	107
206	17- 2	139	....	....	12.0	107
207	17- 3	140	....	92	12.1	108
208	17- 4	141	49	....	12.2	108
209	17- 5	142	....	93	12.3	109
210	17- 6	143	50	....	12.4	109
211	17- 7	144	....	94	12.4	110
212	17- 8	145	51	....	12.5	110
213	17- 9	.....	....	....	12.5	111
214	17-10	146	....	95	12.6	111
215	17-11	147	52	....	12.7	112
216	18- 0	148	....	96	12.8	112
217	18- 1	149	53	....	12.8	113
218	18- 2	150	....	97	12.9	113
219	18- 3	.....	....	....	13.0	114
220	18- 4	151	54	....	13.1	115
221	18- 5	152	....	98	13.2	115
222	18- 6	153	55	....	13.2	116
223	18- 7	154	....	99	13.3	116
224	18- 8	155	56	....	13.4	117
225	18- 9	.....	....	....	13.4	117
226	18-10	156	....	100	13.5	118
227	18-11	157	57	....	13.6	118
228	19- 0	158	....	101	13.7	119
229	19- 1	159	58	....	13.8	119
230	19- 2	160	....	102	13.9	120
231	19- 3	.....	....	....	14.0	120
232	19- 4	161	59	....	14.1	121
233	19- 5	162	....	103	14.2	121
234	19- 6	163	60	....	14.3	122
235	19- 7	.....	....	....	14.4	122
236	19- 8	164	....	104	14.5	123
237	19- 9	165	61	....	14.6	123
238	19-10	166	....	105	14.7	124
239	19-11	167	62	....	14.8	124
240	20- 0	168	....	106	14.9	125
241	20- 1	.....	....	....	15.0	125
242	20- 2	169	63	....	15.1	126
243	20- 3	170	....	107	15.2	127
244	20- 4	171	64	....	15.3	127
245	20- 5	.....	....	....	15.4	128
246	20- 6	172	....	108	15.5	128
247	20- 7	.....	65	....	15.6	129
248	20- 8	173	....	....	15.7	129
249	20- 9	174	....	109	15.9	130
250	20-10	175	66	....	16.0	130
251	20-11	.....	....	....	16.1	131
252	21- 0	176	....	110	16.2	131
253	21- 1	.....	67	....	16.3	132
254	21- 2	177	....	....	16.4	132
255	21- 3	178	....	111	16.5	133
256	21- 4	179	68	....	....	133
257	21- 5	.....	....	....	....	134
258	21- 6	180	....	112	....	134
259	21- 7	181	69	....	....	135
260	21- 8	182	....	....	....	135
261	21- 9	.....	....	....	....	136
262	21-10	183	70	113	....	136
263	21-11	.....	....	....	....	137
264	22- 0	184	71	....	....	137
265	22- 1	185	....	114	....	138
266	22- 2	186	....	....	....	138
267	22- 3	.....	72	....	....	139
268	22- 4	187	....	115	....	140
269	22- 5	.....	....	....	....	140
270	22- 6	188	73	....	....	141
271	22- 7	189	....	116	....	141
272	22- 8	190	....	....	....	142
273	22- 9	.....	74	....	....	142
274	22-10	191	....	117	....	143
275	22-11	.....	....	....	....	143
276	23- 0	192	75	....	....	144
277	23- 1	.....	....	....	....	144
278	23- 2	193	....	118	....	145
279	23- 3	....	....	....	....	145
280	23- 4	194	76	....	....	146
281	23- 5	195	....	119	....	146

(For scores higher than these, see page 16)

1946 Revision

Advanced
Grades 9-Adult

CALIFORNIA TEST OF MENTAL MATURITY—ADVANCED SERIES

Devised by Elizabeth T. Sullivan, Willis W. Clark, and Ernest W. Tiegs

Name..... Occupation or Grade.....

Date..... Age..... Last Birthday..... Sex: M-F

Teacher or Examiner..... School or Organization.....

TEST FACTOR	Possible Score	Score	Low	Average	High
1. Visual Acuity	40	___	0–28	29–40	
2. Auditory Acuity	15	___	0–9	10–15	
3. Motor Co-ordination	20	___	0–10	11–18	18–20

DIAGNOSTIC PROFILE
(Chart scores here)

TEST FACTOR	Possible Score	Score	Yr.	Mental Age Mo.	Percentile Rank
A. Memory	53	___			___
4. Immediate Recall*	33	___	.		
5. Delayed Recall (p. 16)	20	___	.		
B. Spatial Relationships	45	___			___
6. Sensing Right and Left*	20	___	.		
7. Manipulation of Areas*	15	___	.		
8. Foresight in Spatial Sit'n*	10	___	.		
C. Logical Reasoning	60	___			___
9. Opposites*	15	___	.		
10. Similarities*	15	___	.		
11. Analogies*	15	___	.		
15. Inference (p. 14)	15	___	.		
D. Numerical Reasoning	45	___			___
12. Number Series*	15	___	.		
13. Numerical Quantity*	15	___	.		
14. Numerical Quantity	15	___	.		
E. 16. Vocabulary	50	___			___
Total Mental Factors (A+B+C+D+E)	253	___			___
F. Language Factors (5+14+15+16)	100	___			___
G. Non-Language Factors (Total Mental Factors Minus F)	153	___			___
Chronological Age		___			
Actual Grade Placement (Grade pupil is in)		___			

*Non-Language tests.

SUMMARY OF DATA

	Score	M. A.	÷	C. A.*	=	I. Q.
Total Mental Factors	___	___		___		___
F. Language Factors	___	___		___		___
G. Non-Language Factors	___	___		___		___

*Age 16 and older, divide by 192 months.

Published by California Test Bureau

Directions: In each group of letters and numbers, put a circle around the letters and numbers in the second row that are the same as those in the first row of the group.

A.

		D		E		L	3	
V	(D)	O	(L)	C	(3)	R	(E)	N

1.

		Z		X		O	4	
Z	A	N	H	X	O	S	4	R

2.

		C		D		T	6	
R	6	N	J	C	T	H	D	U

3.

		P		5		D	S	
G	D	5	S	X	B	R	P	V

4.

		A		G		R	7	
E	O	R	7	A	C	S	F	G

5.

		D		E		F	3	
H	F	3	C	B	E	X	D	T

6.

		K		Q		A	8	
P	Q	8	V	K	H	A	O	E

7.

		H		9		L	R	
S	E	L	R	J	H	7	M	9

8.

		O		C		3	P	
V	Y	5	O	Q	C	P	X	3

9.

		R		6		B	D	
S	B	T	R	V	D	6	X	8

10.

		Z		4		W	N	
T	M	W	N	K	4	L	Z	E

Test 1. Score (number right).....

TEST 2.

Directions: In each row, put an X on the line under the object that is named. Then write the number of the object you mark on the line to the right.

A



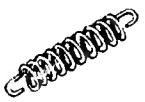
1 _____ 2 _____ 3 _____ A

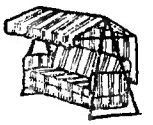
1



1 _____ 2 _____ 3 _____ 1

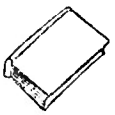
2





1 _____ 2 _____ 3 _____ 2

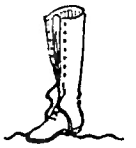
3



1 _____ 2 _____ 3 _____ 3

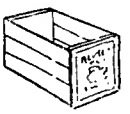
4





1 _____ 2 _____ 3 _____ 4

5


1 _____ 2 _____ 3 _____ 5

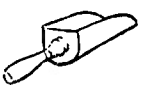
6



1 _____ 2 _____ 3 _____ 6

7





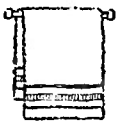
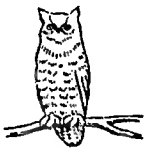
1 _____ 2 _____ 3 _____ 7

8



1 _____ 2 _____ 3 _____ 8

9

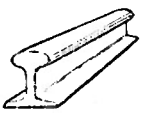
1 _____ 2 _____ 3 _____ 9

10



1 _____ 2 _____ 3 _____ 10

11


1 _____ 2 _____ 3 _____ 11

12



1 _____ 2 _____ 3 _____ 12

13

1 _____ 2 _____ 3 _____ 13

14

1 _____ 2 _____ 3 _____ 14

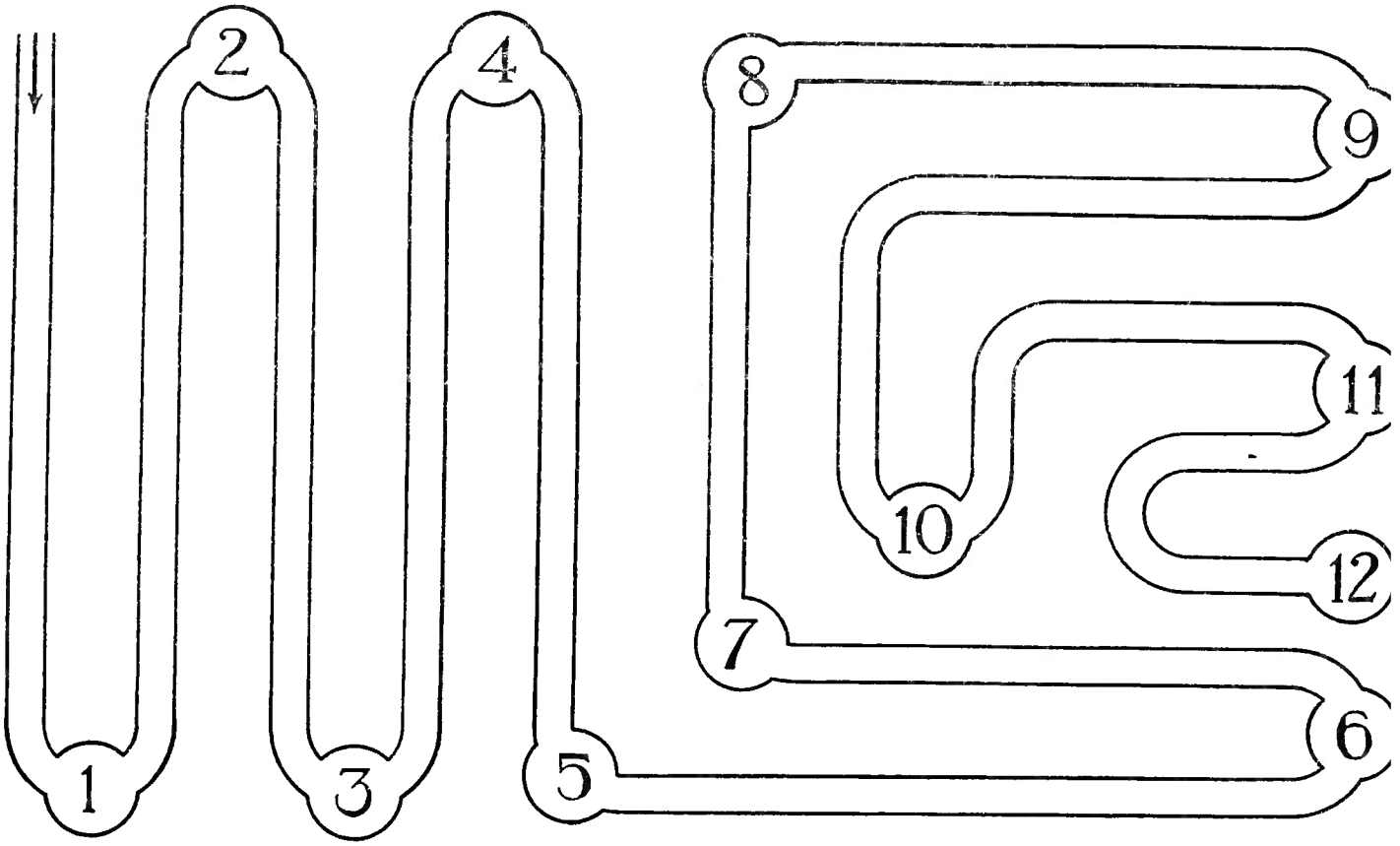
15

1 _____ 2 _____ 3 _____ 15

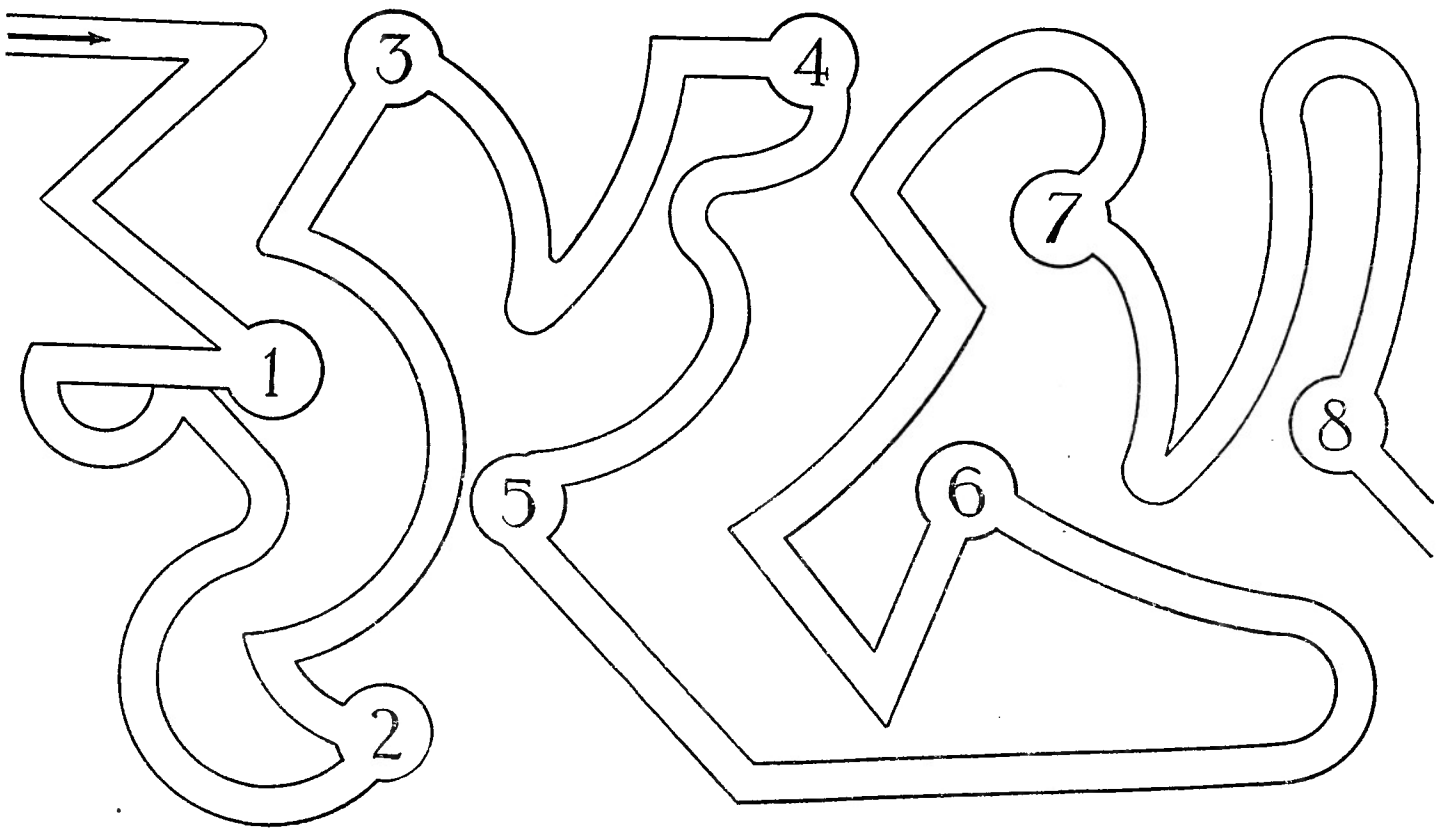
Test 2. Score (number right).....

Directions: Start at the first arrow at A and draw a line to each number when called. Try to kee within the black lines. Do B in the same way.

A



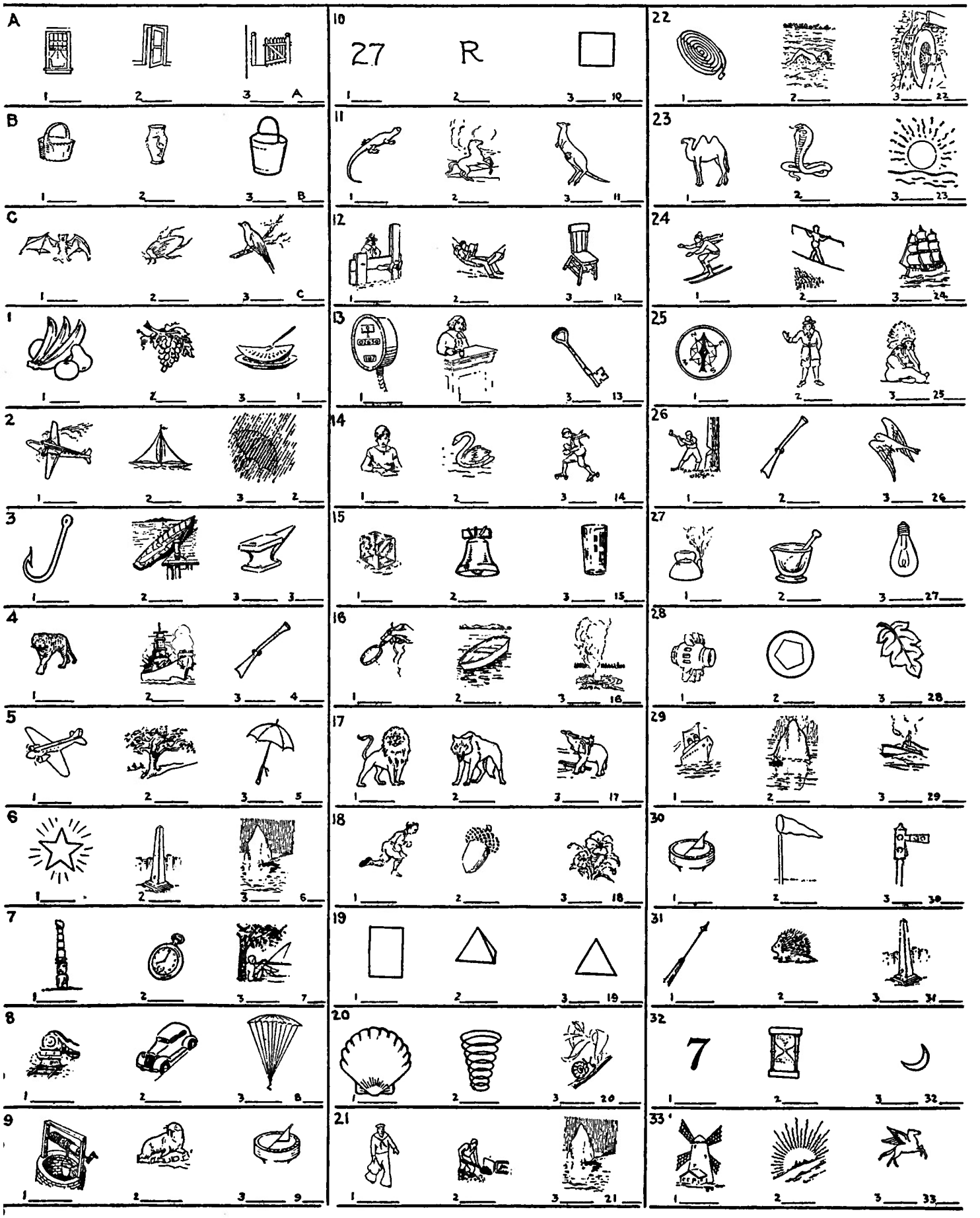
B



Test 3. Score (number right).....

TEST 4.

Directions: Listen to the pairs of words that will be read to you. The first word of each pair will be repeated and you are to remember what went with it. Find the object. Put an X on the line under it and put the number of the object you mark on the line to the right.



Test 4. Score (number right) .....

TEST 6.

Directions: Put a circle around the letter R in all rights. Put a circle around the letter L in all lefts.

A

(R) L

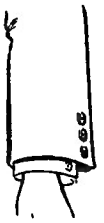
B

R (L)

1

R L

2



R L

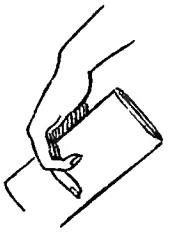
3

R L

4

R L

5



R L

6

R L

7

R L

8

R L

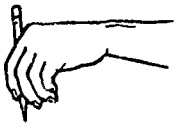
9

R L

10

R L

11



R L

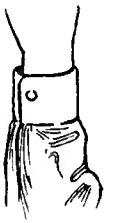
12

R L

13

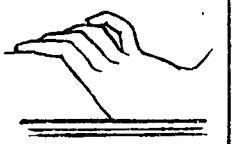
R L

14



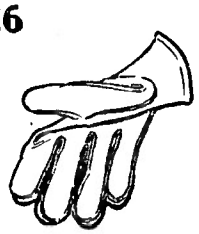
R L

15



R L

16



R L

17

R L

18

R L

19

R L

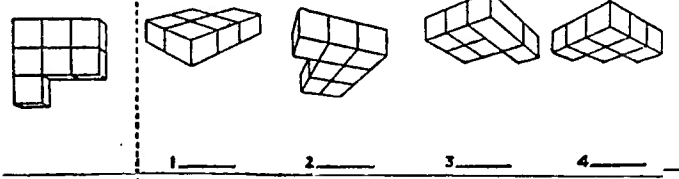
20

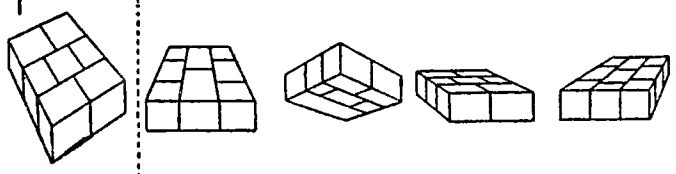
R L

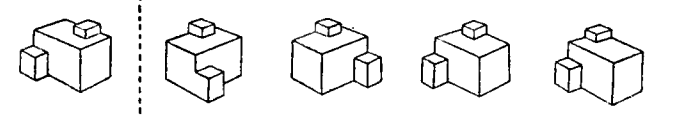
Test 6. Score (number right).....

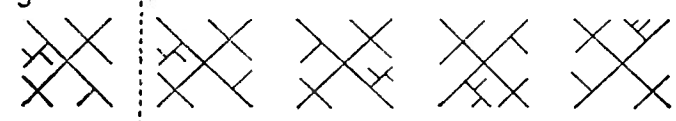
(Test 5 is on page 16.)

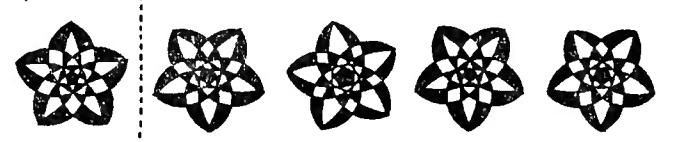
Directions: In each row find a drawing that is either the same drawing or different views of the first drawing. Put an X on the line under this drawing and put the number of the drawing you mark on the line to the right.

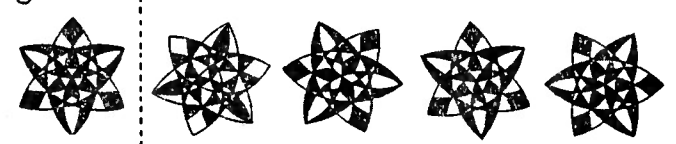
A  1___ 2___ 3___ 4___ ___A

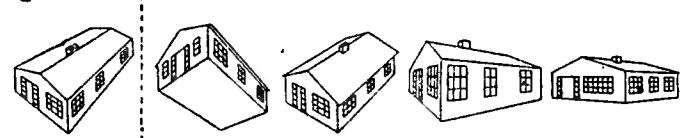
1  1___ 2___ 3___ 4___ ___1

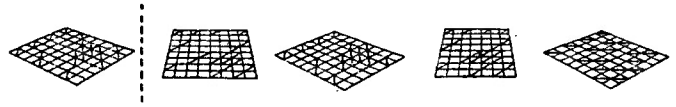
2  1___ 2___ 3___ 4___ ___2

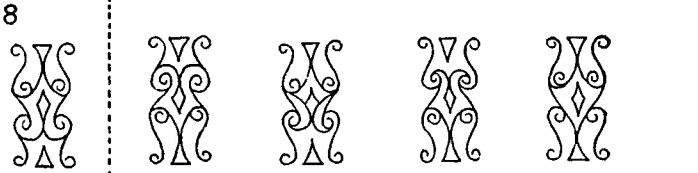
3  1___ 2___ 3___ 4___ ___3

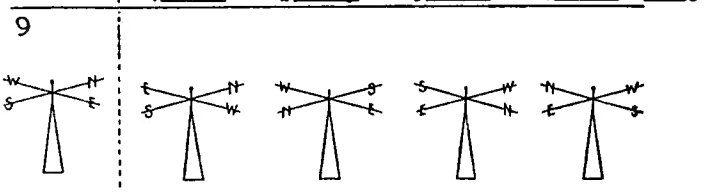
4  1___ 2___ 3___ 4___ ___4

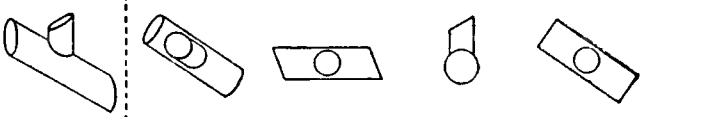
5  1___ 2___ 3___ 4___ ___5

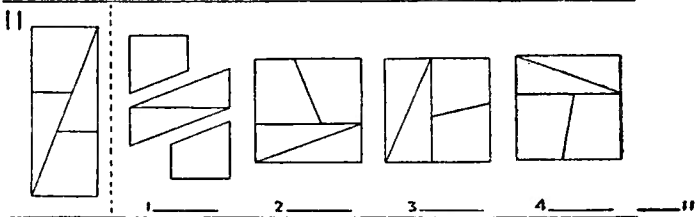
6  1___ 2___ 3___ 4___ ___6

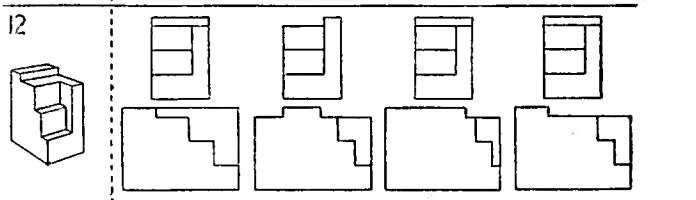
7  1___ 2___ 3___ 4___ ___7

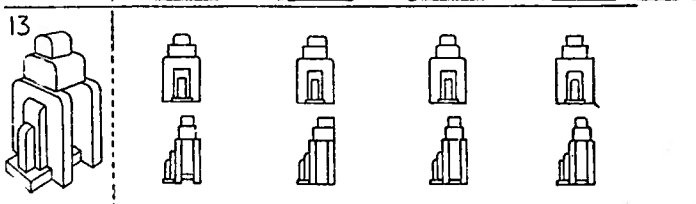
8  1___ 2___ 3___ 4___ ___8

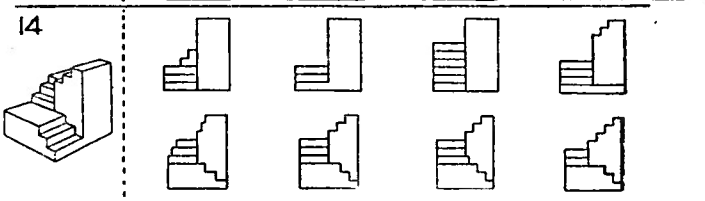
9  1___ 2___ 3___ 4___ ___9

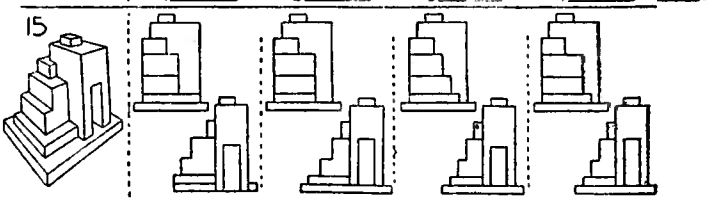
10  1___ 2___ 3___ 4___ ___10

11  1___ 2___ 3___ 4___ ___11

12  1___ 2___ 3___ 4___ ___12

13  1___ 2___ 3___ 4___ ___13

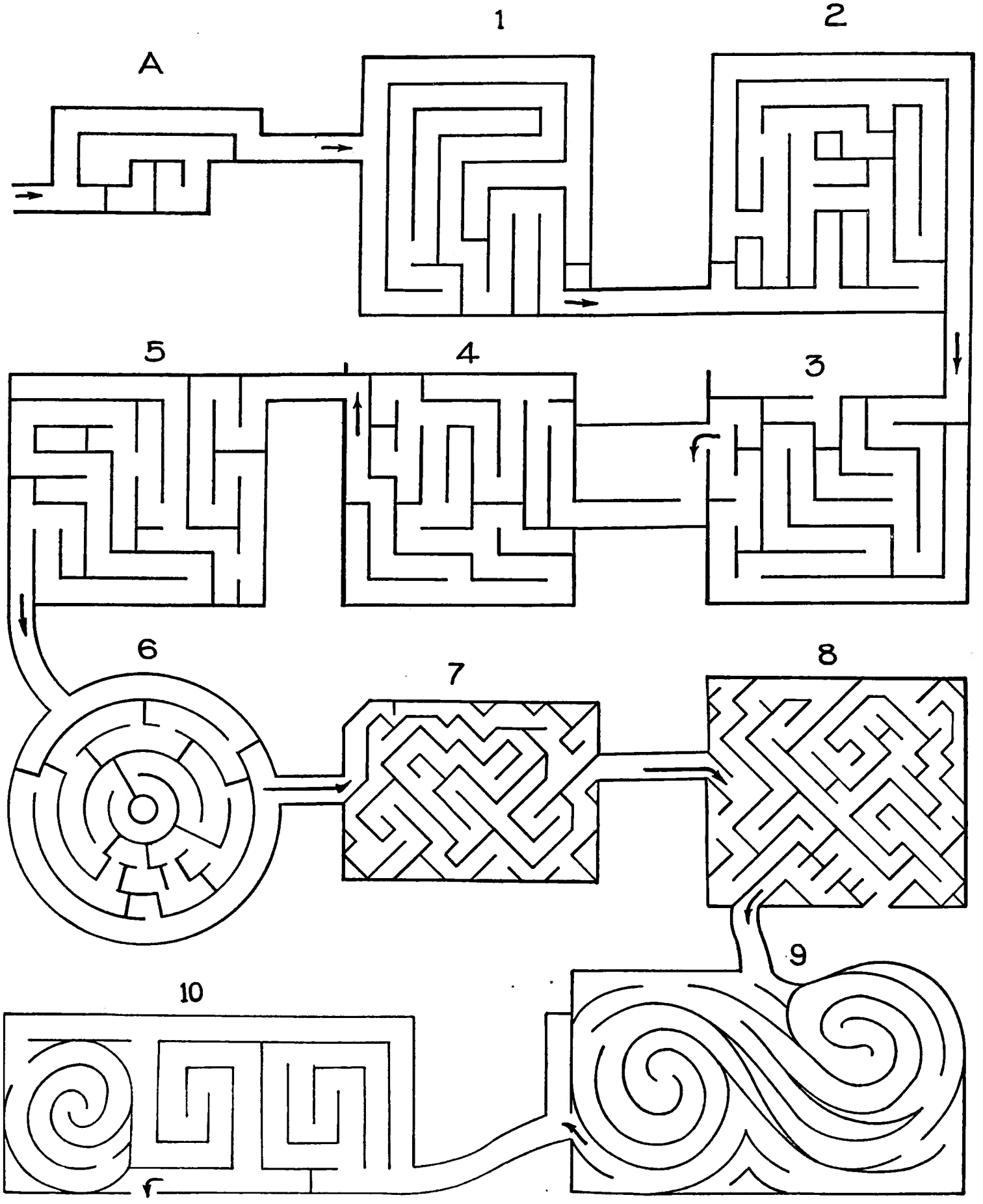
14  1___ 2___ 3___ 4___ ___14

15  1___ 2___ 3___ 4___ ___15

Test 7. Score (number right).....

TEST 8.

Directions: Begin at the arrow in drawing A. Draw a line to show the path you would take through all the drawing so as to finish at the arrow in drawing 10.



Test 8. Score (number completed).....

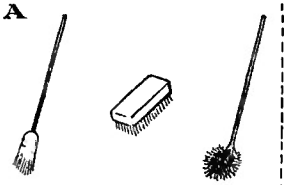
TEST 9.

Directions: In each row there is one object that represents the opposite of the first object. Put an X on the line under it and put the number of the object you mark on the line to the right.

Test 9. Score (number right).....

Directions: The first three objects in each row are alike in some way. Find another object in the same row that belongs with them. Put an X on the line under it and put the number of the object you mark on the line to the right.

A



1 ____ 2 ____ 3 ____ 4 ____ ____A

1

1 ____ 2 ____ 3 ____ 4 ____ ____1

2

1 ____ 2 ____ 3 ____ 4 ____ ____2

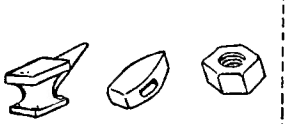
3

1 ____ 2 ____ 3 ____ 4 ____ ____3

4

1 ____ 2 ____ 3 ____ 4 ____ ____4

5



1 ____ 2 ____ 3 ____ 4 ____ ____5

6

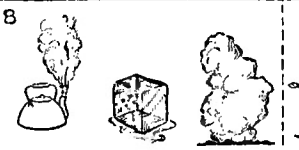
O S C T E U Z

1 ____ 2 ____ 3 ____ 4 ____ ____6

7

1 ____ 2 ____ 3 ____ 4 ____ ____7

8



1 ____ 2 ____ 3 ____ 4 ____ ____8

9

1 ____ 2 ____ 3 ____ 4 ____ ____9

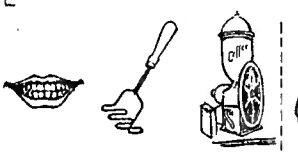
10

1 ____ 2 ____ 3 ____ 4 ____ ____10

11

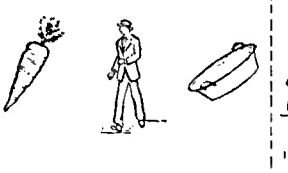
1 ____ 2 ____ 3 ____ 4 ____ ____11

12



1 ____ 2 ____ 3 ____ 4 ____ ____12

13

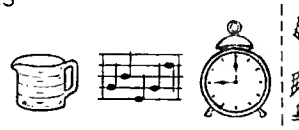


1 ____ 2 ____ 3 ____ 4 ____ ____13

14

1 ____ 2 ____ 3 ____ 4 ____ ____14

15



1 ____ 2 ____ 3 ____ 4 ____ ____15

Test 10. Score (number right).....

TEST 11.

Directions: In each row the first object is related to the second. Find an object that goes with the third object in the same way. Put an X on the line under it and put the number of the object you mark on the line to the right.

Test 11. Score (number right).....

TEST 12.

Directions: In each row of numbers below, there is one that is wrong. Find this wrong number and draw a line under it. Then write it on the line to the right.

Sample:	2	4	6	8	*9*	10					*9*
	11	9	*8*	7	5	3	1				*8*
A.	18	15	13	12	9	6	3				A
B.	½	0	1	2	4	8	16				B
C.	4	5	7	10	11	13	14	16	17	19	C
D.	56	49	43	38	35	34	31	29			D
E.	7	9	10	13	16	19					E
F.	27	25	22	17	12	7					F
G.	3	5	6	11	12	14	15	19	20	21	G
H.	37	34	31	29	27	24	22	21	19		H
I.	1	2	4	7	11	15	16	22			I
J.	18	21	19	22	20	22	23	21	24		J

Go right on with the following until told to stop. In each row of numbers below, the numbers increase or decrease in accordance with a definite series of whole numbers. Supply the missing numbers and also write them on the line to the right.

Sample:	2	*4*	7	9	*12*	14	17	19		*4, 12*
K.	15	16	18	....	21	....	24	25		K
L.	17	19	....	....	23	....	26	28	29	L
M.	27	29	....	28	....	27	24	....	23	M
N.	60	....	55	51	49	....	....	40	37	N
O.	48	....	44	41	....	36	34	....	28	O

Test 12. Score (number right).....

TEST 13.

Directions: In each problem you are to find a certain number of coins to make a certain amount of money. Put the number of coins required under the name of the coin.

Samples	cent	nickel	dime	quarter	half-dollar
2 coins—10 cents		*2*			
7 coins—25 cents	*5*		*2*		
Test					
A. 6 coins—10 cents					
B. 7 coins—15 cents					
C. 3 coins—35 cents					
D. 4 coins—86 cents					
E. 4 coins—45 cents					
F. 4 coins—95 cents					
G. 3 coins—70 cents					
H. 5 coins—42 cents					
I. 5 coins—67 cents					
J. 5 coins—46 cents					
K. 7 coins—93 cents					
L. 6 coins—56 cents					
M. 6 coins—$1.17					
N. 5 coins—$1.36					
O. 15 coins—$5.51					

Test 13. Score (number right).....

Directions: Work these problems on a blank sheet of paper. Write the letter of the answer on the line to the right. The correct answer for the first problem (A) is b.

A. If a man earned $25.00 and spent $10.00, how much money did he have left?
Ans.: a $5 b $15 c $20 d $10 *b* A

1. How many picture post cards can you buy for 15 cents at the rate of 3 for 5 cents?
Ans.: a 9 b 3 c 15 d 34 ____ 1

2. How many feet of railroad track can be laid with 750 ties if 25 ties are needed for each 50 feet?
Ans.: a 1250 b 1500 c 325 d 30 ____ 2

3. What number if multiplied by 3, is 2 times 9?
Ans.: a 3 b 9 c 18 d 6 ____ 3

4. A sample rug is 12 inches long and 9 inches wide. How long will a larger rug of the same proportions be if it is 36 inches wide?
Ans.: a 108 in. b 48 in. c 15 in. d 36 in. ____ 4

5. What is the number which if divided by 4, is $\frac{1}{6}$ of 72?
Ans.: a 12 b 18 c 48 d 3 ____ 5

6. A high school student borrowed $75.00 for one year at 6% to start a chicken ranch. How many little chickens must he sell at 10 cents each to pay back the money he borrowed with interest?
Ans.: a 45 b 450 c 750 d 795 ____ 6

7. A dealer allowed an old customer a discount of 10% on the marked price of book cases. What is the marked price of a book case for which this customer paid him $36.00?
Ans.: a $40 b $32.40 c $3.60 d $39.60 ____ 7

8. A circular flower bed 7 feet in diameter is to be bordered by plants set one foot apart. What will be the cost of the plants at the rate of 2 for 15 cents? (Circumference of a circle is about $3\frac{1}{7}$ times the diameter.)
Ans.: a 52¢ b $1.65 c 70¢ d $1.57½ ____ 8

9. A man placed four stepping stones one foot square in a row in a section of his garden so that there were equal spaces on all four sides of each of the stones. If the section was 3 feet wide, how long was it?
Ans.: a 12 ft. b 3 ft. c 9 ft. d 8 ft. ____ 9

10. Ben lives 1.5 miles east of the library. James lives 2.5 miles directly west of the library. On a scale of ½ inch = 1 quarter mile, how many inches will represent the distance between the boys' houses?
Ans.: a 8 in. b 16 in. c 6 in. d 2 in. ____ 10

11. What is the number which if added to 5 is 3 less than $\frac{1}{3}$ of $\frac{3}{5}$ of 60?
Ans.: a ½ b 9 c 4 d 12 ____ 11

12. A gallon of water weighs 8.4 pounds. A gallon of gasoline weighs 68 per cent as much as a gallon of water. A pilot flying the air mail carried 50 gallons. How many pounds did this gasoline weigh?
Ans.: a 285 b 285.6 c 278.6 d 380 ____ 12

13. A coffee shop buys a blend of coffee composed of $\frac{2}{3}$ of Grade A at 60 cents a pound and $\frac{1}{3}$ of Grade B at 30 cents a pound. If they change the mixture, using $\frac{1}{3}$ of Grade A and $\frac{2}{3}$ of Grade B, how much will they save on every 10 pounds of coffee?
Ans.: a 3¢ b 10¢ c 30¢ d $1.00 ____ 13

14. A man's will provides that his estate of $15,000.00 should be divided as follows: $\frac{2}{5}$ to his wife and $\frac{1}{5}$ each to three children, except that in the event any of the children were deceased, their share should be divided equally between the remaining children and the wife. Two children were killed in an automobile accident. How much did the remaining child receive from the estate?
Ans.: a $\frac{1}{5}$ b $6000.00 c $4500 d $5000 ____ 14

15. If a set of tires for one automobile costs one-half of what a set costs for another automobile; and if three sets of the cheaper tires last only as long as two sets of the more expensive kind, the total cost of the cheaper tires during a given period will average what fraction or per cent of the cost of the more expensive kind?
Ans: a $\frac{1}{3}$ or 33⅓% b ½ or 50% c ¾ or 75% d 1½% ____ 15

Test 14. Score (number right).....

Directions: Read each group of statements and draw a line under the correct logical answer. Write the number of this answer on the line to the right.

0. All four-footed creatures are animals.
All horses are four-footed. Therefore

[1] Creatures other than horses can walk
[2] All horses can walk
[3] All horses are animals — *3* 0

1. Elm Street is parallel to Oak Street.
Oak Street is parallel to Palm Avenue.
Therefore

[1] Elm Street crosses Palm Avenue
[2] Palm Avenue is longer than Elm Street
[3] Elm Street is parallel to Palm Avenue — ——— 1

2. George Washington was a skillful general.
George Washington was President of the United States. Therefore

[1] Skillful generals make good presidents
[2] A President of the United States was a skillful general
[3] Good presidents make skillful generals — ——— 2

3. If he steers toward the land he will be wrecked; and if he steers toward the open sea he will be wrecked; but, he must steer either toward the land or toward the open sea.
Therefore

[1] He should head for the open sea
[2] The coast is dangerous for ships
[3] He will be wrecked — ——— 3

4. If the wind changes it will either grow warmer or it will storm.
The wind does not change. Therefore

[1] It will probably grow warmer
[2] The conclusion is uncertain
[3] It will not grow warmer nor will it storm — ——— 4

5. X is younger than Y.
Y is younger than Z. Therefore

[1] Y is younger than X
[2] X is younger than Z
[3] Y has lived longer than Z — ——— 5

6. All circles are round figures.
The figure is not round. Therefore

[1] It is oval
[2] It is either a square or a triangle
[3] It is not a circle — ——— 6

7. A is situated to the east of B.
B is situated to the east of C. Therefore

[1] C is situated close to A
[2] A is situated to the east of C
[3] C is nearer to A than to B — ——— 7

8. If he is to complete his high school course, he must avoid wasting his energy and his money.
But he will not avoid wasting his energy, or he will not avoid wasting his money. Therefore

[1] He will not complete his high school course
[2] He will be sorry some day
[3] He should be criticized for not doing better ——— 8

9. If the students are in error, your refusal to listen to their side is unreasonable.
If they are not in error, your refusal is unjust.
But, the students are in error or they are not.
Therefore

[1] Your refusal is justifiable
[2] Your refusal is either unreasonable or it is unjust
[3] Your refusal may be reconsidered later ——— 9

10. Three boys are up on a ladder,
Tom is farther up the ladder than Paul.
Jim is farther up than Tom.
Which boy is in the middle position on the ladder?

[1] Tom [2] Paul [3] Jim ———10

11. A is either B or C or D.
A is not B. Therefore

[1] A is C [2] A is either C or D
[3] The conclusion is uncertain ———11

12. If he were loyal he would not speak unkindly of his family in earnest.
If he were wise he would not speak unkindly of them in jest.
Either he speaks unkindly in earnest or in jest.
Therefore

[1] He is either not loyal or not wise
[2] He is unkind [3] The conclusion is uncertain ———12

13. If A is B, E is F; if C is D, G is H.
Either A is B or C is D. Therefore

[1] A is F or C is H
[2] Either E is F or G is H
[3] The conclusion is uncertain ———13

14. A is between B and C.
B is between C and D. Therefore

[1] A is not between C and D
[2] A is between B and D
[3] A is nearer to B than to D ———14

15. Five cities (P, Q, R, S, and T) are in the same state. S is between P and Q. T is between P and S. R is the same distance from P and T and S is the same distance from P and Q.
Therefore

[1] Q is nearer to T than to S
[2] R is nearer to Q than to P
[3] T is nearer to P than to Q ———15

Test 15. Score (number right).....

Directions: Draw a line under the word which means the same or about the same as the first word. Write the number of this word on the line to the right, as:

0. **blossom** [1] tree [2] vine [3] flower [4] garden — *3* — 0

1. **inefficient** [1] avoidable [2] quarrelsome [3] incompetent [4] unruly — 1
2. **confiscate** [1] assert [2] seize [3] compile [4] comfort — 2
3. **malign** [1] insure [2] muffle [3] slander [4] invade — 3
4. **whimsical** [1] accurate [2] fashionable [3] weighty [4] fanciful — 4
5. **avarice** [1] virtue [2] prominence [3] greed [4] honor — 5
6. **eradicate** [1] destroy [2] vacate [3] use [4] solve — 6
7. **impeachment** [1] precedent [2] settlement [3] resignation [4] accusation — 7
8. **discordant** [1] clashing [2] despondent [3] unsteady [4] distinctive — 8
9. **titanic** [1] reddish [2] acid [3] large [4] ancient — 9
10. **edict** [1] decree [2] diction [3] sovereign [4] edition — 10
11. **recumbent** [1] cumbersome [2] curved [3] reclining [4] saving — 11
12. **caprice** [1] action [2] whim [3] capture [4] tact — 12
13. **expedite** [1] expel [2] dictate [3] delay [4] hasten — 13
14. **loquacious** [1] talkative [2] logical [3] legal [4] delicious — 14
15. **idiosyncracy** [1] irritability [2] peculiarity [3] office [4] imbecility — 15
16. **perfidious** [1] treacherous [2] fragrant [3] studious [4] responsible — 16
17. **artifice** [1] artless [2] hate [3] definition [4] device — 17
18. **anomaly** [1] ceremony [2] illness [3] irregularity [4] normal — 18
19. **reciprocal** [1] charming [2] mutual [3] agreeable [4] meditative — 19
20. **travesty** [1] burlesque [2] tragedy [3] meeting [4] hotel — 20
21. **obtuse** [1] pointed [2] reversible [3] blunt [4] objectionable — 21
22. **abstemious** [1] stormy [2] excessive [3] mournful [4] temperate — 22
23. **tangent** [1] blend [2] agent [3] touching [4] sensing — 23
24. **extraneous** [1] extra [2] foreign [3] transparent [4] noisy — 24
25. **erudite** [1] crude [2] learned [3] rugged [4] polite — 25
26. **ameliorate** [1] improve [2] harden [3] dilute [4] decorate — 26
27. **malapert** [1] sick [2] lazy [3] slow [4] saucy — 27
28. **opulence** [1] jewel [2] generosity [3] wealth [4] honor — 28
29. **urbanity** [1] loyalty [2] refinement [3] weakness [4] barbarism — 29
30. **propinquity** [1] nearness [2] curiosity [3] diligence [4] propriety — 30
31. **trajectory** [1] court [2] project [3] area [4] curve — 31
32. **corollary** [1] crown [2] inference [3] enclosure [4] supersede — 32
33. **ostensible** [1] actual [2] available [3] genuine [4] pretended — 33
34. **salient** [1] salty [2] outstanding [3] merciful [4] agreeable — 34
35. **probity** [1] uprightness [2] interference [3] suspicion [4] weight — 35
36. **acephalous** [1] false [2] warlike [3] headless [4] sensible — 36
37. **porphyry** [1] papyrus [2] rock [3] cave [4] manuscript — 37
38. **strident** [1] muscular [2] shrill [3] battered [4] strong — 38
39. **effete** [1] exhausted [2] festive [3] fragile [4] plentiful — 39
40. **tyro** [1] scold [2] village [3] law [4] beginner — 40
41. **perimeter** [1] measure [2] instrument [3] boundary [4] difficulty — 41
42. **diurnal** [1] seasonable [2] occasional [3] timely [4] daily — 42
43. **obloquy** [1] disaster [2] blame [3] pride [4] obligation — 43
44. **eyot** [1] island [2] lake [3] river [4] insect — 44
45. **detritus** [1] fossil [2] dextrous [3] fragment [4] poem — 45
46. **palladium** [1] burden [2] safeguard [3] title [4] residence — 46
47. **quiddity** [1] oddity [2] doubt [3] essence [4] presence — 47
48. **ambient** [1] uncertain [2] surrounding [3] surprising [4] well-wishing — 48
49. **orrery** [1] book [2] prophecy [3] apparatus [4] error — 49
50. **syzygy** [1] separation [2] choice [3] conjunction [4] nonsense — 50

Test 16. Score (number right).....

Directions: Read the following and draw a line under the correct answer. Put the number of this answer on the line to the right.

0. The report read to you a little while ago was about the
[1] Apaches [2] Sioux
[3] Hurons [4] Chippewas 3 0

1. The report dealt chiefly with customs concerning
[1] war [2] hunting [3] fishing [4] dreams —— 1

2. The tribe lived in
[1] Western United States [2] Southern France
[3] Mexico [4] Northeastern North America
—— 2

3. The Huron village was
[1] In the wilderness [2] Near the ocean
[3] On the plains [4] Near the gulf —— 3

4. The centuries with which this report dealt were
[1] 14th and 15th [2] 17th and 18th
[3] 19th and 20th [4] 15th and 16th —— 4

5. Their Manitou was a
[1] Chieftain [2] Medicine man
[3] Guiding spirit [4] The oldest man —— 5

6. The wishes of their Manitou were carried out
[1] Occasionally [2] Frequently
[3] Always [4] Seldom —— 6

7. The wishes of their Manitou were satisfied by
[1] Relating the dream to the captains
[2] Giving a feast in his honor [3] Fasting
[4] Consulting the medicine men —— 7

8. If what they dreamed of was not obtainable for the feast they
[1] Used a substitute [2] Had games instead
[3] Raided the French post
[4] Delayed the feast —— 8

9. If a sick man dreamed that he wished to refurnish his cabin
[1] He did so when he got well
[2] Others asked him for his old things
[3] Men of the village took charge of the refurnishing
[4] He bargained for furnishings —— 9

10. The furnishings given in response to a dream were obtained from
[1] Cabins in the village [2] Dutch traders
[3] Central supply house [4] The French ——10

11. A dream in which an enemy was taken captive was followed by
[1] Peace and quiet [2] War with the enemy
[3] Sending an envoy to the enemy
[4] Feasting in honor of the dreamer ——11

12. If an Indian dreamed that he was taken captive by the enemy he was
[1] Guarded [2] Given to the enemy
[3] Tortured [4] Feasted ——12

13. The Indian who dreamed that he saw 10 men plunging into a river
[1] Warned them
[2] Reported them to the captains
[3] Said nothing about his dream
[4] Invited these men to a diving contest ——13

14. The owner of an object dreamed of by another Indian
[1] Often refused to give it up
[2] Gave it up without protest [3] Usually hid it
[4] Traded it for something the dreamer had
——14

15. The "Game of Dish" was played with
[1] Seeds [2] Shells [3] Beads [4] Stones ——15

16. Neighboring tribes took part in the Game of Dish
[1] On stated occasions [2] When formally invited
[3] In the early spring
[4] When the men were hunting ——16

17. The place of meeting for the Game of Dish was decided by
[1] The dreamer [2] The captains
[3] Drawing lots [4] The invited tribe ——17

18. The Game of Dish was entered into by
[1] Old men principally
[2] Young children and women for the most part
[3] Young men only
[4] Young and old alike ——18

19. The institution of the feast gave the Indians
[1] Little advantage [2] Power over the enemy
[3] Opportunity to satisfy the wishes of their Manitou
[4] Mainly hard work in preparation ——19

20. The custom of the feast tended principally to
[1] Reduce war
[2] Reclaim the covetous and revengeful
[3] Relieve the monotony of primitive life
[4] Increase the general wealth of the tribe——20

Test 5. Score (number right).....

RUCH-POPENOE GENERAL SCIENCE TEST

By GILES M. RUCH, PH.D.
United States Office of Education
and HERBERT F. POPENOE, A.B.
Formerly of Stanford University

MANUAL OF DIRECTIONS (*REVISED*)

INTRODUCTION

Description and purpose of the test. This test is designed primarily to measure the accomplishment of pupils in general and elementary science courses in either the 8th or the 9th grade. It is not based upon any single textbook in general science, nor is it intended to apply to any particular type of a course of study in this subject.

Part I is composed of fifty items of general information concerning familiar elementary scientific facts, principles, concepts, terms, definitions, and applications. These fifty items sample a wide range of relatively simple knowledge in the fields of physics, chemistry, astronomy, agriculture, botany, zoölogy, and physiology.

Part II measures the ability of the pupil to identify apparatus, organisms, structures, and principles, and to apply principles of science to the solution of simple problems. For this purpose twenty diagrams and drawings have been prepared, together with completion exercises based upon these illustrations. It is believed that the use of drawings enlists the interest and effort of the pupils to a greater extent than purely linguistic tests. It is also likely that the pictorial tests involve abilities not found in the information test of Part I, and that these abilities are prominently involved in the laboratory method of instruction.

The Ruch-Popenoe General Science Test is published in two forms, designated as Form A and Form B. These are identical in construction and are of equal difficulty. Either form can be used alone, or both forms can be given and the results averaged. The use of both forms increases the reliability of the scores very considerably. One form can easily be given in a class period of forty-five minutes. The time limits have purposely been made generous enough to make the tests almost entirely power tests, and the slow pupil will not be penalized to any considerable extent. Increasing the time allowance has not been found to increase the scores significantly.

This test should prove of value to teachers of general science in several ways:

1. In the assignment of school marks, by furnishing a more objective and reliable basis than that afforded by the judgment of the teacher alone.
2. In the determination of promotions and failures.
3. In the classification of pupils into sections for the purpose of differentiating rates of progress or for enriching the curriculum of the abler students. In this connection it is advisable that some standard group test of intelligence like those of Otis and Terman[1] be given as well and both sets of test scores be utilized in dividing classes into sections.
4. In comparison of the results obtained by the teacher of one class with the accomplishment of similar classes in the same school or in other localities.

Construction and validation of the test. The selection of the items in the Ruch-Popenoe General Science Test has been based largely upon an analysis of the contents of existing textbooks in general science. Although there are more desirable criteria for the validation of test materials for most school subjects than the one here used, it is nevertheless true that, during the formative period of any new subject, teaching practice follows very closely the organization of the available textbooks. This very practical consideration is held to be sufficient justification for the construction of a test which embodies the best of the materials actually occurring in the books which must be used in general science classes.

[1] Otis Self-Administering Tests of Mental Ability and Terman Group Test of Mental Ability, published by World Book Company, Yonkers-on-Hudson, New York.

Published by World Book Company, Yonkers-on-Hudson, New York, and 2126 Prairie Avenue, Chicago

RPGST: MD
PRINTED IN U.S.A.

The present form of the test is a revision and extension of the Range of Information Test in General Science published in 1919 by one of the authors.[1] The original test consisted of three forms of fifty scientific terms each, which had been selected from a list of more than five hundred of such terms obtained by analysis of twenty-three texts and manuals in general science. Of these five hundred items, about 180 were common to half or more of the texts and for this reason were considered to be valid for test purposes. Some further eliminations necessitated by reasons stated in the articles cited below reduced the final number to 150. These were roughly equated and standardized as three forms of fifty items each.

In the present test, two of these forms have been standardized in more objective form. The ease of scoring has been greatly increased, and greater objectivity of scoring has been made possible.

The selection of the diagrams of Part II was carried out in a manner similar to the information item of Part I, except that the ratings of a number of experienced teachers were secured as an additional guarantee of the desirability and validity of these materials. Some further eliminations were made in order to prevent undue overlapping of the fields covered by Parts I and II.

The tests were carried through two try-outs. The preliminary try-out involved about 250 pupils in ten classes representing five different states. From the results of this try-out the relative difficulties of the separate items were determined and two forms of the test were made and roughly equated. The second try-out was held in order to gather additional data for norms and reliability coefficients. For this purpose four classes in four different states (California, Michigan, Oregon, and Pennsylvania) were used.

Table 1 shows the analysis of the content of the test in terms of percentages for the various fields of science.

TABLE 1

SUBJECT-MATTER ANALYSIS OF THE RUCH-POPENOE GENERAL SCIENCE TEST IN PERCENTAGES

Biological science (botany, physiology, and zoölogy)	30%
Chemistry	12%
Physics and mechanical applications	38%
Earth science (agriculture, astronomy, geology, and physiography)	20%

[1] Ruch, G. M., "A Range of Information Test in General Science," *General Science Quarterly*, 1919, 4, 257–262; and ibid., 1920, 5, 15–19.

Reliability of the test. The reliability coefficients of the test have been computed for several classes by correlating the scores in Form A with those in Form B. Table 2 gives these coefficients.

TABLE 2

RELIABILITY COEFFICIENTS OF THE TEST, FORM A WITH FORM B

School	State	N	Entire test	Part I only	Part II only
1 Westinghouse	Penn.	48	.81	.69	..
2 University High	Oreg.	23	.87	.76	.74
3 Grand Rapids	Mich.	42	.80	.64	..
4 Palo Alto	Calif.	22	.85	.78	.69
Averages			.833	.718	.72

The probable error of a score found from average of these coefficients (.833) by the formula

$$\text{P.E.}_{(\text{score})} = .6745\sqrt{1-r}_{(\text{reliability})}\,\sigma_{(\text{dist. of scores})}$$

is 4 points in score. This means that the chances are even that the score of any individual will be correct within 4 points; that is, that it will not deviate more than 4 points from the hypothetical average of an infinite number of scores of that individual.

DIRECTIONS FOR ADMINISTERING

The directions for giving Form A and Form B are exactly the same. Each test consists of two parts, designated as Part I and Part II.

The examination booklets should be distributed to the pupils, with instructions not to turn over the pages until the command is given. Ask the pupils to fill in the blanks provided for name, grade, and other information. See that each pupil has a sharpened lead pencil before beginning the test. A number of extra pencils should be provided by the teacher in case a pupil should break a pencil point during the examination. The pupils should be instructed to raise their hands as a signal that a pencil point has been broken during the test.

After the blanks have been filled in properly, say to the class:

"Here is a test of a number of facts of science. You will probably not know all the answers, but do as many as you can. If you do not know the answer to a question, do not waste too much time but go on to the next.

"Now, turn over to Part I." After the page has been turned, say: **"Look at the directions**

at the top of the page while I read them: 'Draw a line under the one word or phrase that makes the truest answer to the question, as shown in the sample. Sample: An example of a liquid is iron glass air water lead zinc oxygen.' The only one of these seven things that is a liquid is water. Therefore the word 'water' has been underlined. That is the way you are to answer the questions. Do not write anything. Just draw a line under the right answer. Begin with No. 1 and answer as many as you can before time is called. You will be given 15 minutes to answer the 50 questions. Ready—Go."

After 15 minutes (time to exact second), say: **"Stop! Turn over to Part II."** After the pupils have turned to Part II, say: **"Look at the directions at the top of the page while I read them: 'On this page and the following pages there are 20 diagrams and several statements about each diagram. Part of each statement is left blank. You are to fill each blank so as to make a true statement. Make the statements as complete and definite as possible. In most cases you will need to write but ONE WORD in each blank. You will be given 25 minutes to do this part of the test.' Ready—Go."**

After 25 minutes (time to exact second), say: **"Stop! Close your booklets."** The examination booklets should then be collected at once.

Directions for Scoring

Part I contains 50 items. Each item correctly answered counts one point.

Part II contains 80 blanks to be filled. Each blank properly filled constitutes one correct response. The score in Part II is the number of correct responses divided by 2. (Maximum scores: Part I, 50; Part II, 40; Total, 90.)

A Key containing the correct answers to each question is included in each package of examinations. To score the examination, place the Key over the examination so that the answers on the Key are adjacent to the responses given on the examination. Place a check mark opposite the number or letter of each question at the right-hand side of page, or a cross opposite each wrong or omitted answer, or both checks and crosses.

In scoring Part I, it will save considerable time if a celluloid stencil is used. Such a stencil is quickly made by superimposing a piece of sheet celluloid over the page of the test booklet and then marking a dot with indelible ink over the correct response to each question. In using such a stencil the scorer need only look to see whether the lines and dots coincide. However, the scoring can be done very efficiently without such a stencil by the use of the Keys provided.

To some of the blanks in Part II there are a number of correct responses possible. Where this is true, several correct answers are suggested on the Key as samples of what should be accepted for credit. As a rule, no credit should be given for a response not given on the Key unless there is absolutely no doubt that the pupil's answer is equivalent in merit to those listed as acceptable on the Key. Do not give any partial credits. A response is either given full credit or marked entirely wrong.

Enter the scores of each part in the space provided on the last page of the part. These scores should then be copied into appropriate spaces on the first page of the examination booklet and added to find the total score in the examination.

Recording Scores

There is included in each package of examinations a Class Record on which the scores of 50 pupils may be entered for convenience in filing. This is to be kept by the examiner or school principal.

Interpretation and Utilization of Results

Latest norms. Table 3 gives the latest (1925) norms, based on the scores of 2053 pupils in general science classes. Forty-seven schools and twenty-three different states are represented. Separate norms are given for mid-year (January) and end-year (May and June) classes. Where one-semester courses are given, the January norms are doubtless the more suitable.

TABLE 3

Percentile Norms: Mid-Year and End-Year

	January	*June*	
10% of the pupils reach or exceed	42.7	53.7	
20% of the pupils reach or exceed	37.3	47.5	
25% of the pupils reach or exceed	35.5	45.3	
30% of the pupils reach or exceed	34.0	43.4	
40% of the pupils reach or exceed	31.3	39.4	
50% of the pupils reach or exceed	28.1	35.7	(Median)
60% of the pupils reach or exceed	26.9	30.6	
70% of the pupils reach or exceed	24.7	29.4	
75% of the pupils reach or exceed	23.6	27.9	
80% of the pupils reach or exceed	22.5	26.3	
90% of the pupils reach or exceed	18.8	22.8	
Numbers	654	1399	

Use of results. For most purposes of the teacher of general science the scores can be used without reference to age or grade norms. In order to illustrate some of the possible interpretations and uses of the results, a few scores have been selected from an actual class at the end of the year.

Pupil	Score
A	18
B	34
C	57

In the case of Pupil A, it will be seen by reference to Table 3 that a score of 18 places the pupil in the lowest 10 per cent of the distribution of 2053 unselected pupils. Such a score should be taken as evidence of very poor accomplishment on the part of this pupil and the question of his promotion should be seriously considered. It would be advisable to give the second form of the test as well. It would probably be a safe rule to give both forms of the tests to all pupils earning a score of 28 or less (i.e., the lowest quarter of the distribution) on a single form. Pupil B with a score of 34 can be rated as approximately average, since the median score is 36. Pupil C, who earned a score of 57, can be rated as doing very superior work, surpassing the attainments of more than ninety pupils in a hundred.

Although it is not advised that the results of the tests alone be used for determining promotions or for the assignment of grades, nevertheless, the greater objectivity and reliability of the test scores should cause the test results to be weighed heavily in deciding these questions.

In schools where general science serves as a required introductory subject to the science curriculum, the tests may serve an important function in deciding which pupils should be encouraged to elect the more advanced and specialized science courses.

The test can also be used, as was previously suggested, to differentiate pupils into "fast-," "average-," and "slow-moving" groups in order that the more capable pupils be given the opportunities of an enriched curriculum. Intelligence tests are almost a necessity in this connection in order that a pupil's accomplishment in science can be compared with his native capacity to acquire knowledge. Considerable evidence is now at hand which indicates that general intelligence is probably the most important single factor conditioning the rate of learning. For this reason a pupil in the 9th grade with a mental age of 13 years who earns a score of 30 in this test is probably more nearly achieving his maximum results than a pupil who earns a score of 40 with a mental age of 17 or 18 years. The same principle should be applied in comparing the results of different teachers, since equal attainments can be justly expected only where the range of talent is similar in the classes to be compared. Too much stress can hardly be laid on this frequently overlooked point in educational measurement.

RUCH-POPENOE GENERAL SCIENCE TEST

By GILES M. RUCH, PH.D.
United States Office of Education
and HERBERT F. POPENOE, A.B.
Formerly of Stanford University

EXAMINATION: FORM B

Primarily for Grades 8 and 9

Do not open this paper, *or turn it over, until you are told to do so. Fill these blanks, giving your name, age, birthday, etc. Write plainly.*

Name .....
(First name, initial, and last name)

Age last birthday .....*years. Birthday* .....
(month and day)

Grade .....*Teacher* .....

School .....*City* .....

Date of examination .....

Part	*Score*
I	
II	
Total	

Published by World Book Company, Yonkers-on-Hudson, New York, and 2126 Prairie Avenue, Chicago

PART I

DIRECTIONS. Draw a line under the one word or phrase that makes the truest answer to the question, as shown in the sample.

SAMPLE. An example of a liquid is iron glass air <u>water</u> lead zinc oxygen

---

Begin here.

1 Wind-deposited piles of sand are called
moraines loess deltas drumlins dunes meanders monadnocks..... 1

2 The path of a heavenly body is called its
circumference orbit inclination radius equator latitude declination..... 2

3 Soft coal is also known as anthracite asphalt lignite bituminous basalt creosote peat 3

4 Galileo invented the
printing press cotton gin microscope telescope dynamo camera steamboat 4

5 Boiling point of water on the Centigrade thermometer is 0° 32° 100° 120° 180° 212° 273° 5

6 A vacuum is characterized by the absence of
moisture heat atmosphere objects gravity light motion..... 6

7 The process by which plants and animals change their food materials into soluble form is known as absorption putrefaction digestion photosynthesis osmosis peristalsis respiration..... 7

8 The passage of the moon between the sun and the earth is called an eclipse of the sun full moon third quarter eclipse of the moon eclipse of the earth winter solstice equinox..... 8

9 An organism which derives its food from a living host is a
saprophyte larva spore toxin parasite legume chrysalis..... 9

10 Distance east and west around the earth is called
longitude altitude declination rotation revolution inclination latitude..... 10

11 Formaldehyde is often used as a
dye vaccine developing agent disinfectant cleaning agent fertilizer stimulant 11

12 The vertebræ are parts of the heart brain muscles nerves backbone teeth toes 12

13 Hot-air furnaces heat rooms chiefly by
radiation convection evaporation gravitation fusion induction conduction.. 13

14 A kind of serum is often used in the treatment of
diphtheria smallpox rheumatism heart trouble malaria goiter Bright's disease 14

15 The largest of the planets is Venus Saturn Mars Jupiter Uranus Neptune Earth 15

16 A metal much used for electric-light filaments is
copper manganese iron iridium bronze tungsten aluminum..... 16

17 An example of a lever of the first class is found in the nutcracker scissors wheelbarrow spring balances inclined plane screw biceps muscle..... 17

18 An illustration of the action of capillarity is found in the
ink blotter thermometer barometer force pump action of the lungs excretion of urea absorption of the products of digestion..... 18

19 Combustion is another name for
freezing drying boiling expanding shrinking burning melting..... 19

20 Rocks formed by the action of heat are called
bituminous metamorphic sedimentary igneous stratified anthracite conglomerate 20

21 The term "induction" is used most in connection with
levers pumps pulleys falling bodies solutions pendulums electric currents 21

22 Voltaic cells are studied in
geology botany bacteriology photography zoölogy electricity psychology... 22

23 The resistance a body offers to being set in motion is called
momentum friction cohesion erosion voltage inertia fusion..... 23

24 The aneroid barometer depends upon the action of
alcohol mercury metal membrane electric current buoyancy friction light 24

25 Escaping illuminating gas mixes with the air of the room by
capillarity diffusion cohesion valence radiation gravitation chemical affinity 25

26 The smallest of these things is the
molecule bacterium yeast plant paramecium dust particle red blood corpuscle atom 26

27 The unit of weight in the metric system is the
liter ounce meter pound ton gram cubic centimeter..... 27

28 The ovum or egg cell is produced in the
stamen kidney embryo seed ovary gamete receptacle..... 28

29 The ampere is a measure of
air pressure humidity resistance gravitation current potential temperature 29

30 White dome-shaped clouds in the late afternoons of hot days are usually
cirrus stratus altus cirro-stratus tornadoes cumulus fog..... 30

31 The processes which tend to level down the earth's surface are collectively termed
vulcanism sedimentation erosion metamorphism stratification adhesion reduction 31

32 Refraction is studied in connection with
sound gravity heat falling bodies buoyancy light electricity..... 32

33 Isobars are used in diagraming
magnetism rainfall temperature air pressure humidity winds gravitation.. 33

34 An example of a fungus plant is the
mistletoe orchid clover pond scum bread mold Indian pipe mother of vinegar 34

35 Gases enter and leave the leaves of plants through organs called
stipules tracheids root hairs stomata micropyles cotyledons chloroplasts.. 35

36 Another term for an anti-cyclone is a low-pressure area tornado hurricane
high-pressure area typhoon trade wind horse latitudes..... 36

37 Potential energy is energy possessed by an object by virtue of its
weight combustibility motion position density temperature structure..... 37

38 A food rich in carbohydrates is
beefsteak olive oil butter cucumbers watermelon salt honey..... 38

39 The main purpose of respiration is
energy release elimination of carbon dioxide purification of the blood manufacture of food
elimination of wastes secretion of water purification of the air 39

40 The density of a solid is usually compared with that of
air hydrogen water lead oxygen wood nitrogen..... 40

41 The corolla is made up of the
petals pistils sepals stamens ovaries receptacles petioles..... 41

42 Lodestones are characterized by their hardness density crystalline structure
phosphorescence magnetism transparency brilliant coloration..... 42

43 A solid which liberates a gas when mixed with water is said to be
effervescent fulminating deliquescent transparent translucent amorphous anhydrous 43

44 The attraction between molecules of two different bodies is called
capillarity adhesion magnetism inertia buoyancy cohesion surface tension 44

45 Archimedes' principle has to do with light pumps pulleys inertia motion buoyancy sound 45

46 Precipitates are always poisonous soluble solids liquids gases colorless white 46

47 Substances without crystalline structure are termed
inert plastic dense viscous elastic opaque amorphous..... 47

48 A ferment is another name for a bacterium enzyme toxin ptomaine vaccine serum anti-body 48

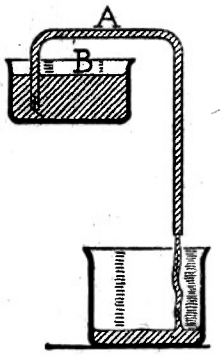
49 The simplest independent living structure is the
nucleus protoplasm cell cell wall embryo molecule atom..... 49

50 The nucleus is believed to play a prominent part in
excretion digestion respiration heredity locomotion storage of food nerve conduction 50

Score in Part I _____

PART II

DIRECTIONS. On this page and the following pages there are 20 diagrams and several statements about each diagram. Part of each statement is left blank. You are to fill each blank so as to make a true statement. Make the statements as complete and definite as possible. In most cases you will need to write but ONE WORD in each blank. You will be given 25 minutes to do this part of the test.



Begin here.

FIGURE 1

a This figure illustrates the facts of the ..... *a*

b The greatest distance that portion A of the tube can be placed vertically above the level of the water at B, if the apparatus is to work successfully, is about .....feet at sea level. *b*

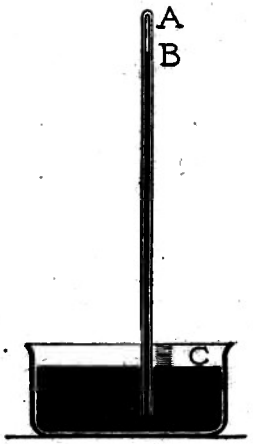


FIGURE 2

The tube shown has been filled with mercury and then inverted in a dish filled partially with mercury.

a Such an apparatus is called a..... *a*

b The height of the column of mercury from B to C at sea level is about .....inches. *b*

c The pressure of the air in the part of the tube from A to B equals about.....pounds per square inch. *c*

d The pressure of the air on the surface of the mercury in the dish is about.....pounds per square inch. *d*

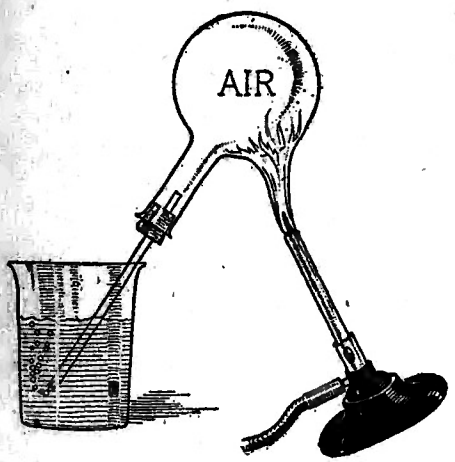


FIGURE 3

a This apparatus illustrates the.....of gases when heated. *a*

b When the flame is taken away, the water in the vessel will .....in the tube due to the.....of the air as its.....is lowered. *b*

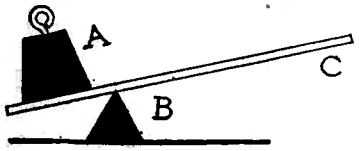


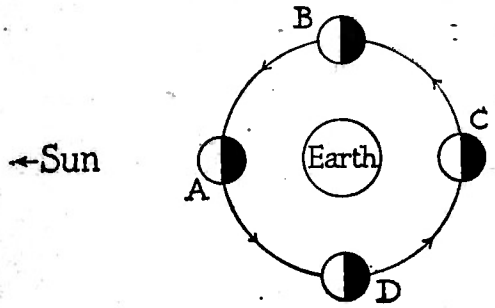
FIGURE 4

a In this lever the power or force is applied at..... *a*

b The fulcrum is placed at the point marked ..... *b*

c The mechanical advantage of this lever as drawn is ..... than 1. *c*

Figure 5



This diagram illustrates the phases of the moon.

a When the moon is at position A, it is called..... *a*

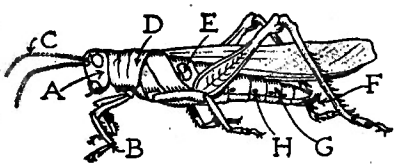
b When the moon is at position B, it is called..... *b*

c When the moon is at position C, it is called..... *c*

d When the moon is at position D, it is called..... *d*

e The time required for a complete revolution of the moon about the earth is approximately.....days. *e*

Figure 6



In this drawing of a grasshopper:

a The head is marked by the letter ..... *a*

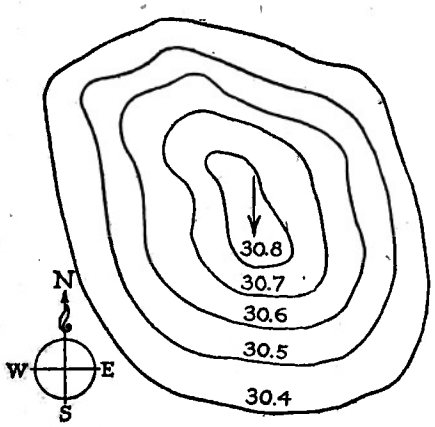
b The thorax is marked by the letter..... *b*

c The abdomen is marked by the letter..... *c*

d The spiracles are marked by the letter..... *d*

e The ovipositor is marked by the letter..... *e*

Figure 7



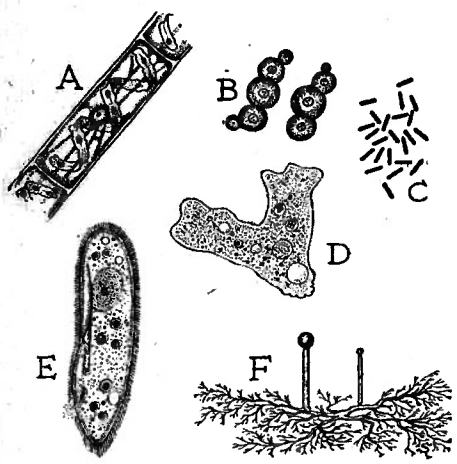
a In the barometric map shown at the left, the region shown is termed a..... *a*

b The more or less circular curved lines are called..... *b*

c A wind starting to blow southward from the center of this area, in the northern hemisphere, will be turned to the..... due to the.....of the earth. *c*

d The weather in this area is likely to be..... *d*

Figure 8



In this figure:

a An amœba is marked by the letter ..... *a*

b Bacteria are marked by the letter ..... *b*

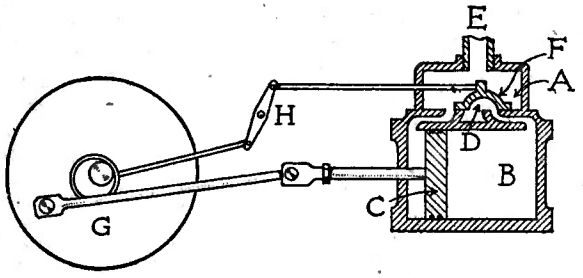
c Bread mold is marked by the letter ..... *c*

d Yeast plants are marked by the letter ..... *d*

e A paramecium is marked by the letter..... *e*

f Spirogyra is marked by the letter ..... *f*

Figure 9



In this drawing of a steam engine:

a The fly wheel is marked by the letter ..... *a*

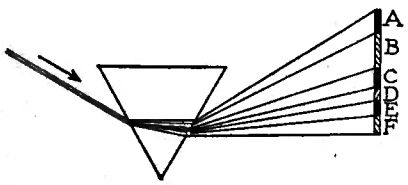
b The piston is marked by the letter ..... *b*

c The steam chest is marked by the letter ..... *c*

d The cylinder is marked by the letter ..... *d*

e The sliding valve is marked by the letter ..... *e*

Figure 10



In this diagram of the action of a prism on a ray of light, the violet rays of the spectrum are shown at .....A.....

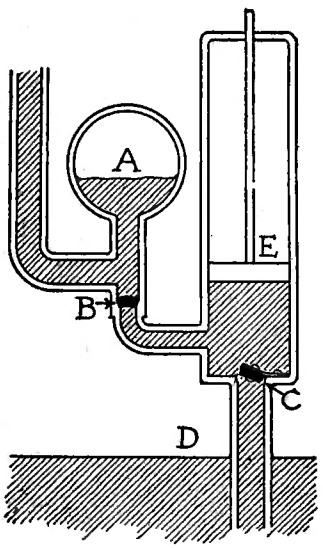
a The orange rays of the spectrum are shown at ..... *a*

b The blue rays of the spectrum are shown at ..... *b*

c The green rays of the spectrum are shown at ..... *c*

d The red rays of the spectrum are shown at ..... *d*

Figure 11

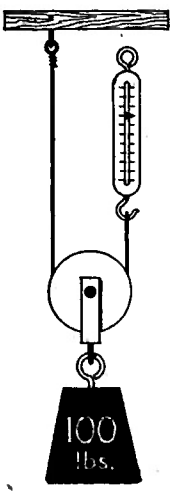


a This is a diagram of a ..... *a*

b The valve which opens on the down stroke is lettered..... *b*

c The device shown at A is termed the .....
Due to the.....of the air in A, the flow of water continues during the.....stroke of the piston. *c*

Figure 12



a The mechanical advantage of this pulley system is..... *a*

b The rule for the mechanical advantage of any pulley system is that the mechanical advantage is equal to the number of times the cord passes to and from the..... .....pulley. *b*

c Disregarding friction, the force needed to lift the 100-pound weight shown is.....pounds. *c*

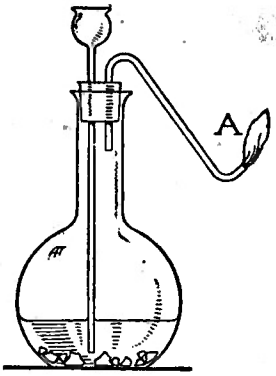


FIGURE 13

a In the apparatus shown, some hydrochloric acid has just been poured into the thistle tube so as to act on the bits of zinc in the flask. The gas which is burning at A is..... *a*

b This gas is.....than air. *b*

c The compound which is being formed in the flask is ..... *c*

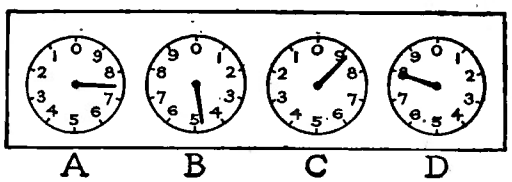
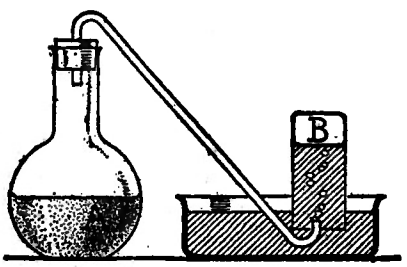


FIGURE 14

a The electric meter shown registers a total of..... kilowatt hours. *a*

FIGURE 15



a In the flask shown at A there is a solution of molasses to which some yeast has been added. The gas which is being collected at B is ..... *a*

b If this gas is passed into....., a..... .....will be formed. *b*

c There will be formed in the liquid in the flask at A a quantity of ..... *c*

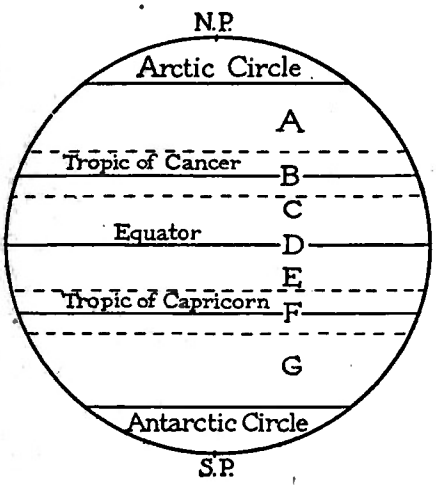


FIGURE 16

In this map of the chief wind zones of the earth:

a The trade winds of the northern hemisphere are lettered..... and those of the southern hemisphere are lettered..... *a*

b The westerly winds of the northern hemisphere are lettered..... and those of the southern hemisphere are lettered..... *b*

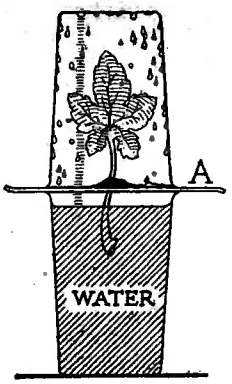


FIGURE 17

a This diagram illustrates the giving off of..... *a*
by the leaves of plants.

b This process is called..... *b*

c The rate of this process in the living plant is partly controlled by the action of the.....found in the..... *c*
of leaves.

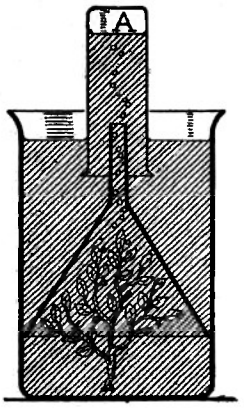


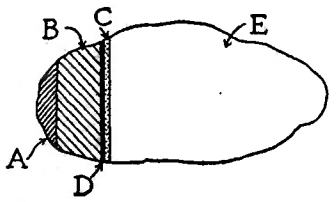
FIGURE 18

a A green water plant has just been placed in the apparatus shown and placed in the sunlight. The gas which is being collected at A is
..... *a*

b A glowing splint placed in this gas will..... *b*

c This illustrates a phase of the physiological process known as
..... *c*

FIGURE 19



In this potato, the food materials which are contained are shown in rough proportions by the parts A, B, C, D, and E.

a The fat content is the section marked by the letter..... *a*

b The carbohydrate content is the section marked ..... *b*

c The water content is the section marked ..... *c*

d The protein content is the section marked ..... *d*

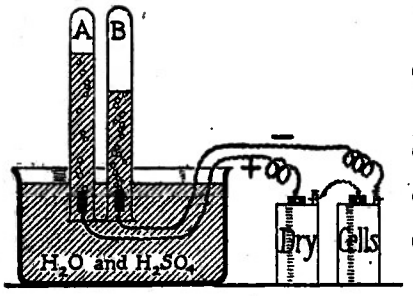


FIGURE 20

a This apparatus illustrates the.....of water by
..... *a*

b The gas which is being collected at A is..... *b*

c The gas which is being collected at B is..... *c*

d The correctness of your answer to item *c* can be proved by showing that the gas collected at B ..... *d*

Number of blanks correctly filled _____ ÷ 2 = *Score in Part II* _____ 17